A Citizen's Handbook to Address Contaminated Coal Mine Drainage

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Acknowledgments
Many people contributed their expertise to the preparation and review of this publication. EPA and OSM would especially like to thank the group of ad hoc citizens and government personnel who provided input in its development and review. The document was prepared by Tetra Tech, Inc under EPA contract #EPA-903-K-97-003.

Additional Copies
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THE PURPOSE OF THIS GUIDE

This guide is intended to familiarize citizens and grassroots groups with the history and chemistry of coal mine drainage (CMD) from abandoned mines and to provide the tools needed to attack the problem creek by creek, river by river, until the waters of Appalachia once again run clean.

The guide provides an overview of the step-by-step process of contaminated CMD clean-up and the role that citizens and grassroots groups can play in that process. The steps include:

Step 1. Understanding Coal Mine Drainage
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It is ***not*** a technical or regulatory document: it is a guide for citizens who want to join with public agencies, universities, businesses, industry and other watershed stakeholders, to do something about CMD from abandoned mines in their watershed.

THE PROBLEM

Cleaning up and protecting waterways is built on three main principles:

- *First, the target watersheds should be those where pollution poses the greatest risk to human health, ecological resources, desirable uses of the water, or a combination of these factors.*
- *Second, all parties with a stake in the specific local situation should participate in the analysis of problems and the creation of solutions.*
- *Third, the actions undertaken should draw on the full range of methods and tools available, integrating them into a coordinated, multi-organization attack on the problems.*

Environmental Impacts from CMD

Contaminated water seeping from abandoned coal mine areas is the most severe water pollution problem in the coal fields of the Appalachian mountains of the eastern United States. Although there are many possible contaminants in and around abandoned mines, the most common and severe problem is the formation of acid mine drainage (AMD), which can kill fish and aquatic insects, stunt plant growth, eat away concrete and metal structures, raise water treatment costs, and color stream banks and beds a bright, rusty, garish orange. In addition, AMD can leach toxic concentrations of metals like iron, and aluminum from mine rocks, causing further contamination of creeks, rivers, and ground water. The problems of coal mine drainage are not always from AMD; toxicities of certain metals and even alkaline mine drainage can cause water quality problems in the eastern United States.

While millions of dollars in water treatment have been spent on CMD, serious problems remain. More than 7,500 miles of Appalachian streams are affected by CMD, with 80 percent of them in western Pennsylvania and West Virginia.

Economic Impacts of CMD

The Pennsylvania Fish and Boat Commission estimates the economic losses from CMD impacts on fisheries and recreational uses in that state alone at $67 million annually.

The U.S. Bureau of Mines estimates that the mining industry spends about $1 million a day on treatment at working mines. Clean-up projects at abandoned mines often involve costs in the hundreds of thousands of dollars and more. However, lost revenues from degraded recreational areas, increased drinking water treatment costs, and the impact CMD can have on local communities is often much greater than the expense involved in preventing and treating it. Successful clean-up projects, though often expensive, have significant impacts on communities and their economic development potential. For example, after a heavily contaminated 13-mile stretch of Pennsylvania's Clarion River was restored through the efforts of a CMD clean-up coalition, a thousand delighted people turned out to witness the first fish-stocking. The revitalization of parts of the Clarion has led to a proposal to designate the waterway as a National Wild and Scenic River, a distinction enjoyed by only the Nation's highest-quality waters. The environmental, economic, aesthetic, and community benefits of cleaning up CMD make the endeavor more than worthwhile.

THE CHALLENGE

Eliminating CMD from abandoned mines and restoring rivers and streams to a healthy state represent significant challenges. While the federal Surface Mining Control and Reclamation Act of 1977 (SMCRA, often pronounced "smack-ra" or "smick-ra") provides a powerful vehicle for citizen and agency oversight of post 1977 mining operations, the authority for government action at pre-law, or abandoned mines is limited; identifying parties responsible for conditions at abandoned sites is difficult and often impossible.

Considering the scope of the challenge and the resources required to mount a successful clean-up program, it is widely recognized that an active, cooperative partnership between involved citizens, academia, industry, and public agencies is essential in attacking CMD from abandoned mines. For more information on SMCRA and citizen involvement under SMCRA, see **Appendix B.**

What are "Pre-law" Mines?

Pre-law mines *refer to coal mines that were abandoned before the 1977 Surface Mining Control and Reclamation Act (SMCRA) law took effect. This guide specifically addresses these "pre-law" mines since the authority and resources for government action at these sites is limited and the magnitude of the problem is so great.*

A FRAMEWORK FOR ACTION

Starting in the 1930's under the Works Progress Administration (WPA) program, through the 1970's with "Operation Scarlift," and continuing up to the present under the various abandoned mine land programs, public agencies have been actively working to tackle CMD. To bring greater awareness, attention, and resources to abandoned CMD, the Office of Surface Mining (OSM) Appalachian Clean Streams Initiative (ACSI) and the U.S. Environmental Protection Agency (EPA) Region 3 Coal Mine Drainage Initiative (CMDI) have teamed up to provide leadership to a coalition of parties interested in CMD. In 1995, the coalition developed the Statement of Mutual Intent (SMI) Strategic Plan. The SMI provides a framework for action to address water quality problems at abandoned coal mines; more than 80 parties have signed the SMI.

Objectives of the Statement of Mutual Intent

Build a clearinghouse to share and exchange data and information identifying mine drainage sites and catalogue abatement technologies that can restore water quality adversely affected by CMD.

Raise public awareness about the serious environmental problems associated with abandoned coal mine drainage.

Focus efforts to target streams degraded by mine drainage for cleanup.

Work to develop and apply the best technology available for cleaning up and preventing contaminated mine drainage.

Support an effective remining program to eliminate some of the mine drainage problems.

Provide forums to transfer technology and other information about improving and restoring watersheds degraded by mine drainage.

Develop shared information management systems to minimize overlap in data collection and development.

Prepare periodic reports describing the extent and severity of the mine drainage problem and the current status of ongoing efforts to improve and restore degraded watersheds.

Role of Citizens and Grassroots Organizations

Participation by citizens and grassroots organizations in the watershed is critical because they often have the greatest understanding of the problem, as well as the greatest interest in cleaning up the stream or creek. The role of citizens and the organizations they form was highly regarded by the coalition of public agencies and nongovernment groups involved in developing the 1995 SMI. A progress report issued by the group in 1995 noted that:

> *"Grassroots organizations, in the form of watershed coalitions, associations, advocacy groups, improvement committees, etc., are the heart and soul of the movement to clean up [contaminated] mine drainage and polluted streams."*

ABOUT THIS GUIDE

This guide was developed through a cooperative effort by an ad-hoc citizen's workgroup, EPA Region 3, and the Office of Surface Mining (OSM). It has been designed to help citizens understand CMD issues and clean-up options for abandoned coal mine drainage sites.

A Citizen's Handbook to Address Contaminated Coal Mine Drainage was one of the needs identified in the SMI Strategic Plan. The guide does not contain engineering specifications for treatment systems, detailed information on water testing methodologies, or parameters for computer modeling of affected watersheds. It does, however, provide a straightforward explanation of the issues involved, actions required to address them, and references for more comprehensive discussions on the various topics.

Two CMD case studies are woven throughout the guide to highlight where watershed groups have successfully tackled CMD problems. The case studies are clearly identified with icons.  refers to the Oven Run Project in Somerset County, PA, and  refers to the Mill Creek Project in Clarion and Jefferson Counties, PA. In addition, the guide provides a resource information section at the end of each step for those who want more information on the material covered.

Appendices are located at the end of the guide that include the following:

Appendix A: Glossary of Terms
Appendix B: Information on the Federal Surface Mining Control and Reclamation Act of 1977
Appendix C: Watershed Delineation Instructions
Appendix D: Stream Water Quality Form
Appendix E: Detailed Information on Treatment Technologies
Appendix F: Matrix of Possible Funding Sources
Appendix G: Fact Sheet on Frequently Asked Questions About OSM's Appalachian Clean Streams Initiative (ACSI) Funding

Step 1: Understanding Coal Mine Drainage

In This Chapter...

- Defining Coal Mine Drainage
- Pre-1977 Mining Practices and the Formation of CMD
- Resource Information

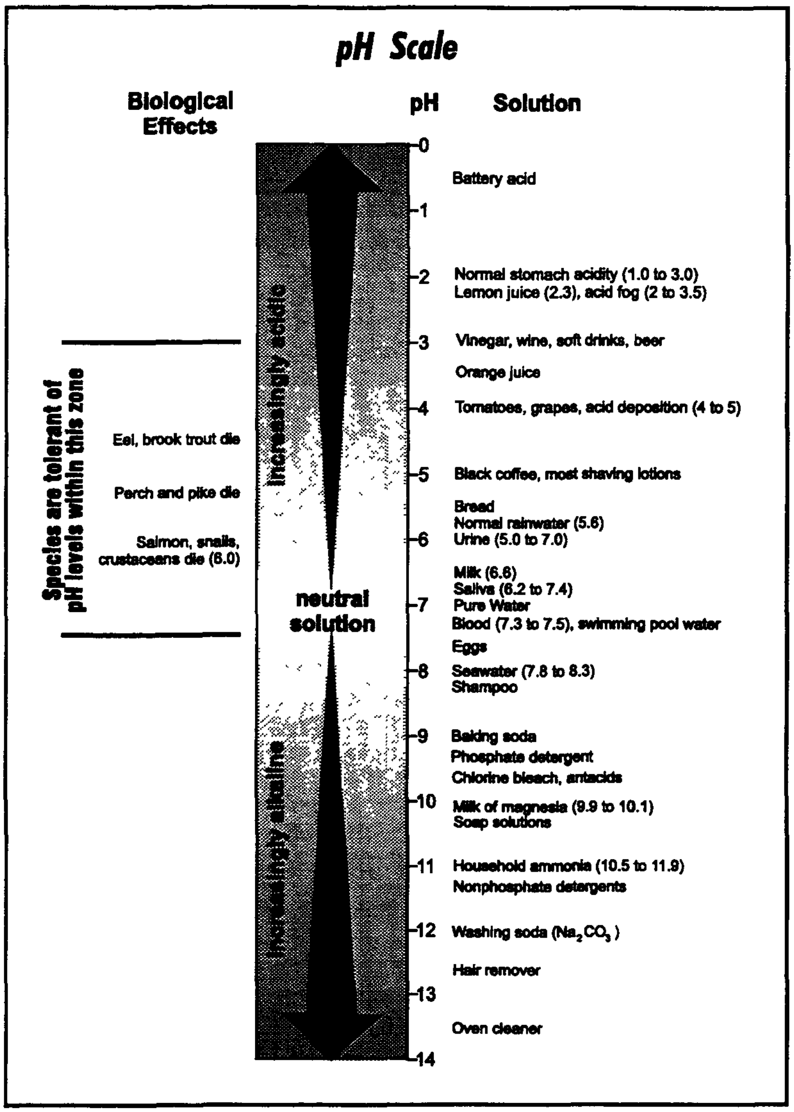
DEFINING COAL MINE DRAINAGE

Coal Mine Drainage (CMD) from abandoned mines is water which is affected by passage through, or alteration by, coal or abandoned coal mine environments. CMD can have acceptable water quality, but often it is contaminated. Contaminated CMD can lower water quality and impair aquatic life, and is most often characterized by one or more of the four major components:

- Low pH (high acidity), i.e., acid mine drainage (AMD)
- High metal concentrations
- Elevated sulfate levels
- Excessive suspended solids and/or siltation

Low pH (high acidity)

The majority of CMD problems result from surface water contact with the unreclaimed waste rock and other earthen materials or from the seepage or drainage of ground water which has con-



tacted the coal or rock strata remaining in an underground mine. If the water becomes acidic, it is referred to as "acid mine drainage" (AMD). Acid is a contaminant of primary concern since it can leach toxic concentrations of metals from rocks at mine sites.

Acids in streams are a problem because they can corrode metal pipes and structures, break down concrete, and kill or stunt plants and other aquatic life-forms. Acidic surface waters or runoff can also break down metallic compounds of iron, sulfur, manganese, and aluminum found in nearby rock or earthen waste piles.

Where does the acid come from?

Acid solutions form when surface or ground water comes into contact with acidic material, mostly pyrite, commonly found in mine rocks, earthen refuse piles, or underground mine works and/or auger holes. The iron-sulfide mineral pyrite is often found near subsurface coal seams along with compounds containing manganese, aluminum, and other metals. In the presence of oxygen, ordinary rain water or ground water can react with the sulfur to form sulfuric acid.

Chemical Formula to Form Contaminated CMD

A simplified version of the chemical process that forms contaminated CMD is shown below.

Pyrite (iron sulfide) + oxygen + water react to create sulfuric acid + iron hydroxide (yellow boy)

Acid concentrations in CMD can reach levels that are more than 10,000 times higher than neutral waters, presenting a powerful leaching agent that can dissolve significant amounts of metal compounds and leach additional acid from rocks and earthen wastes commonly found at most mine sites.

High Metal Concentrations

Layers of rock and earth above the coal removed during mining commonly contain traces of iron, manganese, and aluminum and can also contain other heavy metals. These metals can be dissolved from mining sites through the action of acid runoff, as described above, or can be washed into streams as sediment. Many metals, though common, can be toxic to fish and other aquatic organisms when they are present in high dissolved concentrations. Dissolved iron and iron precipitate, for example, can kill the aquatic biota that fish feed on, thus reducing the overall fish population. Iron precipitate can also clog the gill structures of fish which will eventually lead to their death as well. In addition, precipitation of iron in the stream channel can also wipe out the aquatic food chains and adversely affect fish populations.

Elevated Sulfate Levels

As pyrite wastes are chemically broken down, a sulfate compound is produced in runoff waters. Sulfates can bond with water molecules to form sulfuric acid or can attach to calcium atoms to form a gypsum sludge. Elevated sulfate levels are often found in CMD discharges.

Excessive Silt and Suspended Solids

Most people think contaminated CMD results from chemical reactions in streams, but a significant threat to water quality and aquatic organisms comes from eroding soils at abandoned mining sites. Tiny fly nymphs, insect larvae, and other organisms that form the base of aquatic food chains can be wiped out by heavy accumulations of soil and mine waste particles that wash into streams after rain events. Suspended silt particles can clog the gills of fish and smother eggs on the stream bottom. Streams and rivers muddied by silt and other suspended solids also mean higher costs at municipal and industrial water treatment plants and accelerated sedimentation in reservoirs.

What Do These Colors Mean?

White: *High dissolved aluminum concentrations are deposited as a whitish powder as the aluminum is oxidized back into solid form.*

Black: *Oxidized manganese appears as a dark or black stain on creek rocks*

Orange/Yellow: *Oxidized iron has an orangish, rusty color. Ferric (iron) hydroxide gives CMD-contaminated streams and seeps their characteristic rusty, yellow-orange appearance. Nicknamed "yellow boy," the substance forms after iron is leached from iron sulfide wastes contained in rocks at mining sites.*

OVEN RUN

Oven Run, located in Pennsylvania's Shade Township, is one of several tributaries that discharge CMD into Stoneycreek River. Stoneycreek River flows north from Somerset County to "The Point" in Johnstown, where it joins the Little Conemaugh to form the Conemaugh River. Millions of tons of coal were removed from mines in the Oven Run watershed during past decades, and CMD problems were significant. The estimated flow of CMD at one site alone exceeded 700,000 gallons per day (gpd). Degradation from Oven Run and other tributaries severely impacted aquatic life at Stonycreek River's downstream locations, which did not support the thriving trout fishery found above the CMD sites.

MILL CREEK

Mill Creek drains a watershed that covers nearly 60 square miles within Clarion and Jefferson Counties in western Pennsylvania. The Main stem of Mill Creek is approximately 15 miles long, with the upper two-thirds of the channel and some tributaries supporting a viable population of native brook trout. The lower third of the main stem, from the confluence with Clarion River to a point about six miles upstream, had been so badly polluted by acid mine drainage over a 50-year period that most aquatic life had disappeared. Little Mill Creek, which empties into the lower third of Mill Creek, is the largest tributary and primary contributor of CMD. Ten CMD discharges were identified in the Little Mill Creek watershed.

PRE-1977 MINING PRACTICES AND THE FORMATION OF CONTAMINATED CMD

Knowing how the coal was mined can provide you with clues as to where to look for the sources of contamination. All past mining approaches sought to remove coal from beneath sometimes thick layers of soil and rock called overburden. Many of the various coal-mining practices exposed the sulfur-containing rocks and minerals to the weather, and in some cases, to groundwater flow.

There were and continue to be two approaches to mining: removing the overburden to get at the coal (surface or strip mining) or extracting the coal while leaving the overlying material in place (underground or auger mining). Underground mining has accounted for approximately 70 percent of the Appalachian mining production in the past. Surface (or strip) mining, underground mining, and augering were all common to the Appalachian region.

It has been estimated that 70 percent of the existing acid drainage in Appalachia is the result of past underground mining operations (1969 ARC report).

Surface Mining

Surface mining was practiced where coal beds were at or near the surface of eroded hillsides. Operators removed the overburden with various excavating equipment to expose the coal outcrops. The amount of material disturbed by this technique depended on the thickness and quality of coal being mined, but in most situations, resulted in more than just the near surface zone. The overburden fill is left in the area and if located along drainage zones, can become a source for acid formation if sulfur-containing materials are present and exposed to water.

Auger Mining

Auger mining is the process of drilling out coal seams from a vertical highwall with a large auger. This practice often accompanies the contour mining process. Augers could penetrate horizontally more than 200 feet into a seam, removing as much as 60 percent of the coal. Waste material brought out with the coal was sometimes placed back into the auger holes to prevent subsidence and tension cracks at the surface. Auger holes can be a source of contaminated drainage if rain percolates through the overlying layers and seeps into the holes.

Underground Mining

Removing coal through a process of tunneling through the relatively soft coal beds is among one of the oldest, and still most common, mining practice. In this practice (also called deep mining), vertical, horizontal, and/or entire sloping mine works were constructed to provide access to the coal seam and to remove dust and recharge fresh air supplies. Many old, abandoned underground mines are honeycombed with miles of tunnels, capable of collecting huge amounts of water. As this water passes through the overburden and the maze of tunnels in the coal, it can react with the various acid-forming materials (if present) and create strong concentrations of acid.

RESOURCE INFORMATION

Appalachian Clean Streams Initiative. Office of Surface Mining. n.d. *Appalachian Clean Streams Initiative: A Plan to Clean Up Streams Polluted by Acid Drainage.* Brochure explains what AMD is, how it can be eliminated, and discusses the mission of the Appalachian Clean Streams Initiative.

Focusing on the Problem of Mining Wastes: An Introduction to Acid Mine Drainage. Durkin, T.V., and J.G. Herrmann. Reprint from EPA Seminar Publication No. EPA/625/R-95/007, Managing Environmental Problems at Inactive and Abandoned Metals Mine Sites. Obtained from Internet: http:www.info-mine.com/technomine/enviromine/publicat/amdintro.html.

Office of Surface Mining's WWW Home Page is accessible through the internet at http://www.osmre.gov. OSM, 1951 Constitution Avenue, Washington D.C. 20240; (202) 208-2782.

Robertson GeoConsultants, Inc., hosts an online technical discussion group on mining and related environmental issues. It can be accessed by e-mailing listproc@info-mine.com. An informative web site hosted by the group can be accessed at http://www.info-mine.com/technomine/enviromine/wetlands/welcome.htm.

Stoneycreek-Conemaugh River Improvement Project (SCRIP) of Pennsylvania maintains a homepage on the Internet at http://ctcnet.net/scrip. This site contains a rich variety of information on CMD and links to other resources on the World Wide Web.

U.S. Department of Agriculture Natural Resources Conservation Service. See county listings for local offices.

U.S. Department of Energy, Morgantown Energy Technology Center, 3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507-0880; Robert Bedick 304/285-4505.

U.S. Environmental Protection Agency Region 3 (Maryland, Virginia, Pennsylvania, West Virginia) is at (215) 597-3429; 841 Chestnut Building, Philadelphia, PA 19107.

U.S. Environmental Protection Agency Region 4 (Kentucky, Tennessee, North Carolina, Georgia) at (404) 347-2126; 61 Forsyth Street, Atlanta, GA 30303.

U.S. Environmental Protection Agency Region 5 (Ohio) is at (312) 886-0209; 77 West Jackson Blvd., Chicago, IL 60604.U.S.

U.S. Department of the Interior, Office of Surface Mining, 1951 Constitution Avenue, Washington D.C. 20240; (202) 208-2782.

U.S. Forest Service. *User Guide to Solid - Mining and Reclamation in the West.* Intermountain Forest and Range Experiment Station, U.S. Forest Service, Ogden, UT. Gen. Tech. Report. INT-68, SEAM; 1979.

Step 2: Getting Organized

FINDING POTENTIAL PARTNERS

The extensive problems of contaminated CMD from abandoned mines far outweigh the limited resources and regulatory authority that are available to agency staff to tackle this problem alone. Cleaning up CMD from abandoned mining sites requires citizens, business and industry representatives, agency staffs, and the research community to work cooperatively and collaboratively.

Where dedicated, committed citizens—and the local groups they represent—have joined with government researchers and commercial interests in battling CMD, real progress has been achieved.

What Is Happening in Your Watershed?

If you can answer "not much," maybe **YOU** should consider providing the spark. Chances are, others in your area feel the same way you do about the problems in your creeks and rivers. They are probably just like you—waiting for someone to take the lead. While government personnel can help to involve their agencies and leverage funding, the "spark" for many clean-up projects has come

In This Chapter...

- Finding Potential Partners
- Outreach Is Important
- Forming a Watershed Partnership
- Resource Information

Where Do I Start?

How do I find others to help tackle the problem?

Should I try to educate the general public on the problem?

Who will test the water, identify contaminated CMD sources, check out clean-up options, investigate funding opportunities, hire the contractors, install the treatment technologies, and monitor the results?

Potential Partners Are Everywhere

- *State, county, and local offices of environmental protection (including conservation districts)*
- *Federal offices: U.S. Environmental Protection Agency, Office of Surface Mining, National Park Service, National Resource Conservation Service, U.S. Forest Service, U.S. Army Corps of Engineers, U.S. Geological Survey*
- *Local businesses*
- *Environmental organizations*

from interested, motivated private citizens and businesspeople. Communities must voice their concerns and desires and initiate action to address the problems plaguing their localities.

Identify Partners

Public agencies involved in abandoned mine lands, soil and water conservation, and water quality should be high on the list of potential partners. Glancing through the phone book "blue-page" listing of government agencies provides a good starting point. One or two good contacts in a public agency can often generate a list of a dozen or more potential public agency and university partners who will be valuable in providing background information, identifying available water quality and mining data, and developing links to public and private funding sources for project implementation.

Reaching out to other organizations with an interest in water quality, such as hunting clubs, fishing groups, civic clubs, youth organizations, and others will help establish a strong base and bring diverse perspectives to your efforts.

OUTREACH IS IMPORTANT!

As you begin to publicize your efforts and develop your group membership, consider various outreach approaches including:

- posters;
- inexpensive brochures and newsletters;
- presentations to civic clubs and other organizations;
- newspaper articles;
- art contests;
- events like trash clean-ups and water quality fairs.

OVEN RUN

In order to address the very significant CMD problems in the watershed, a coalition of government and non-government organizations converged in the early 1990's to devise a unified strategy. The Somerset County Conservation District and the Stoneycreek Conemaugh River Improvement Project (SCRIP) is a coalition of agencies, organizations, and individuals interested in improving the water quality of Oven Run, Pokeytown Run, and the four-mile stretch of Stoneycreek River from Oven Run to the Borough of Hooversville. SCRIP was formed in 1991 when U.S. Representative John Murtha realized that the developing remediation project lacked central authority, making it difficult to manage. Local sponsors of SCRIP are contributing 50 percent of CMD remediation costs, or about $2,500,000.

Messages can range from public education (e.g., the estimated impact CMD is having on recreational opportunities in the area) to solicitations for attendance and involvement at meetings or special events.

Keep the effort in the public eye to help keep your partners motivated and bring new members into the process. While you are promoting your project and related educational efforts to the public, keep in mind the old adage of advertising practitioners:

Reach x Frequency = Results

You want to reach as many people with your information with as much frequency as possible to achieve the desired results, whether your objectives are increased attendance at your meetings, elevated knowledge of CMD and clean-up methods, or additional funding for your project. A well-conceived, carefully planned step-by-step approach to outreach in your watershed will generate interest and increase participation in your efforts.

Finally, remember that your primary goal is to clean up the water. It is easy to find fault with what was done (or not done) in the past, but rehashing history often does not translate into positive action in the present or future. Keep the focus on the work necessary to accomplish your objectives.

Building Blocks to Better Outreach

Effective outreach involves the following steps:

- *Define your objective*
- *Identify and characterize the target audience*
- *Develop the desired message*
- *Select the delivery vehicle (medium) for the message*
- *Deliver the message*
- *Evaluate the results*

FORMING A WATERSHED PARTNERSHIP

As your group begins to analyze the problems, educate the public, and recruit interested agencies and organizations, involvement will grow. Building an organization takes awareness, planning, involvement, thought, and work. There will be early struggles, some setbacks and periodic pressures. It is helpful to recognize that these difficulties are normal, and that real progress can be achieved through a cooperative, inclusive process that focuses on the overall goal: cleaning up the watershed and keeping it clean.

Why Form a Partnership?

Developing a watershed partnership to tackle your project ensures that no single entity will be seen as responsible for the work; all interested agencies, organizations, civic groups, elected officials, businesses, industries, and individuals will feel that they have a stake in the process and its outcome. This approach also creates an effort that is much more than the sum of its individual parts or members and it provides the organizational strength and maturity needed to weather the challenges and minor glitches that will surely come.

Partnerships are Forming

The Appalachian Clean Streams Initiative (ACSI), founded by OSM in 1994, is currently supporting coalition-based projects, lead by local citizens, to clean up tributaries of the Cheat River in West Virginia and Monday Creek in southeastern Ohio. Other alliance activity is sprouting up on Pennsylvania's Lackawanna River and Little Toby Creek, on the Tug Fork at the Kentucky-West Virginia border, and on dozens of other Appalachian waterways.

Getting Organized in the Real World

The best advice on organizing and "getting the ball rolling" comes from citizen activists in the field. Rod Piper of the Stoneycreek-Conemaugh River Improvement Project (SCRIP) provides the following insights:

- *People like to work on what affects them personally.*
- *Make your activities known to potential public and private-sector partners using an outreach program, including newspaper articles and other approaches.*
- *Success often means getting the ear of local elected officials, who can identify funding sources and interest them in supporting the project.*

Roles of a Watershed Partnership

The partnership's role is many faceted. Momentum must be maintained through meetings and other forms of information transfer and new members should be recruited. Citizen members:

- help collect the information and data needed to define problems and secure funding for remediation projects;
- secure cooperation from local landowners whose land may be affected by a project and help get assistance from non-government people and groups as needed;
- ensure government agencies' interest in the project to secure the necessary funding; and
- are key to the continued maintenance and effectiveness of the remedial measure after the project is completed.

Public agencies and some formal organizations that join the partnership like to develop specific lists of roles they will play in the effort. These can often be outlined in a memorandum of agreement, memorandum of understanding or other document. These documents serve to identify responsibilities, workloads, and participation.

"Grassroots organizations are initially formed by environmentally conscious citizens whose goal is to clean up a . . . degraded watershed. As the partnership grows, its composition changes to include, in addition to the local and other citizen organizers, representatives from: federal, state and local government agencies; academic institutions ranging from grade schools to universities; foundations; environmental groups; local businesses and industry; public service organizations; and others. The final success of the effort depends upon the contributions that each person and group makes."

– Statement of Mutual Intent Strategic Plan

Recruit Volunteers

Volunteers form the backbone of many CMD and watershed protection coalitions. Since volunteers usually are able to work on only an intermittent basis, it is important to manage their efforts so they fit well into the overall scheme of activity.

Volunteers can handle assignments ranging from writing letters to the editor to taking water samples (see next section), and they are indispensable in planning and executing public awareness projects like clean-ups, water quality fairs, and other events. Attracting volunteers from partner organizations and the general public is vital in establishing your partnership as a vibrant agent of action and change.

Establishing a Nonprofit Corporation

To better organize a watershed partnership and establish eligibility for direct funding from governmental agencies, private foundations and individuals, partnerships can organize as nonprofit corporations under Section 501(c)(3) of the U.S. Internal Revenue Code. The benefits of this approach include:

- eligibility for grant funding;
- lower bulk mailing rates;
- limited liability for board members;
- tax exemptions; and,
- the ability to hire staff.

There is some paperwork in creating a nonprofit corporation and reporting income and expenses, but if your partnership has the membership resources to handle these tasks they are not too difficult. Filing fees are usually less than $500.

If an established nonprofit organization (i.e., Resource Conservation and Development Council, river protection organization, etc.) is available to serve as a funding vehicle for your partnership activities, consider working through that organization before creating a new one.

Tips for Working With Volunteers

Know their skills; try to fit task assignments to skill areas if possible.

Provide clear instruction and supervision to avoid confusion.

Make tasks self-contained, so responsibility assignments are evident.

Help volunteers understand how their tasks fit into the overall goals.

Put volunteers to work in teams to add a social dimension and fun to the work.

Thank them, invite them back, and publicly recognize their efforts.

CMD Info on the Web

A good place to interact with new and established watershed partnerships is on the Internet.

The Stoneycreek-Conemaugh River Improvement Project (SCRIP) of Pennsylvania maintains a homepage on the Internet at http://ctcnet.net/scrip. This site contains a rich variety of information on CMD and links to other resources on the World Wide Web.

The U.S. Geological Survey has a CMD-related site at http://water.wr. usgs.gov.

Robertson GeoConsultants, Inc. hosts a technical discussion group on mining and related environmental issues that can be accessed by e-mailing listproc@info-mine.com. An informative web site hosted by the group can be accessed at http://www.info mine.com/technomine/enviromine/wetlands/ welcome.htm.

Another interactive discussion group is at http://www.microserve.net/~doug/index.html, with information on CMD from the same host located at http://www.microserve.net/~doug/aciddra.html.

The Office of Surface Mining's WWW Home Page is accessible through the internet at http://www.osmre.gov/astart2.htm.

The Friends of the Cheat web site can be found at http://tipswww.osmre.gov/~lwindle/cheat2.htm.

The Clean Streams listserve can be found at cleanstream@osmre.gov.

Tips for Productive Meetings

Establish a clear agenda; allow time for each item and some indication of the desired outcome.

Sit in a circle or semi-circle so each person can see the others.

Appoint a timekeeper, and stick to the agenda. If additional time is needed on an item or other items arise, have the group decide how to proceed.

Encourage everyone to speak, and don't allow one or two individuals to monopolize the dialogue.

Sum up points that have been made to facilitate understanding and speed up the process.

The chair should help guide the group to achieve resolution of the action items by identifying important points and alternatives and clarifying decisions.

Identify tasks, responsible parties, and time frames for action specified.

Set the date, time, and place for the next meeting; and establish a process for updating those who could not attend.

Steps to Incorporation

- Identify the incorporator (often an attorney who helps with the legal paperwork for the corporation);
- Elect a board of directors and officers;
- Draw up the articles of incorporation and by-laws;
- File the documents with the secretary of state's office; and
- Apply to the IRS for a federal tax exemption.

Do we have to?

Although incorporating has some benefits, many partnerships are able to operate quite successfully without pursuing this option. CMD restoration projects funded by public agencies can often proceed under the jurisdiction of the agency itself. Sometimes partnership member organizations are able to serve as funding conduits for grant funds on behalf of the watershed partnership. It will be up to your group to decide which path is best. The key point is not to get bogged down in organizational detail unless it is essential to the project's success. ***People want to spend their time cleaning up the creek, not attending endless meetings on bureaucracy and paperwork!***

MILL CREEK

In the spring of 1990, representatives from private and governmental organizations met to discuss ways to improve the quality of water in Mill Creek. Attendees at that first meeting included members of community groups, environmental organizations, environmental consulting firms, biology professors from Clarion University, representatives from the PA Game Commission and Fish and Boat Commission, U.S. Soil Conservation Service and Conservation District personnel, and elected officials from the region. The initial discussions led to organization of a conference to discuss the feasibility of improving the quality of water in Mill Creek, and the formation of a watershed coalition to achieve this goal.

As a result of the initial meetings and subsequent conference, the Mill Creek Coalition was formed by the following partners: The Alliance for Wetlands and Wildlife, Damariscotta Environmental Consultants, Clarion County Conservation District, Jefferson County Conservation District, Clarion County Federation of Sportsmen, Jefferson County Federation of Sportsmen, Iron Furnace Chapter of Trout Unlimited, Magic Forest of West-Central Pennsylvania, League of Women Voters of Clarion County, Seneca Rocks Audubon Society, and the Natural Resources Conservation Service.

RESOURCE INFORMATION

Watershed Partnerships

Building Local Partnerships. CTIC. An overview and explanation of teamwork among groups, challenges and benefits, how partnerships develop, obstacles, selecting technical advisors, conducting effective meetings, and team building exercises. Contact CTIC at (765) 494-9555.

A Citizen's Action Guide to River Conservation. The Conservation Foundation. A "how-to" book to encourage concerned citizens. Emphasizes building multi-interest citizen coalitions through community involvement and stream conservation efforts.

Clean Water in Your Watershed: A Citizen's Guide to Watershed Protection. Terrene Institute. 1993. Washington, DC. Guide designed to help citizen groups work with local, state, and federal government agencies to design and complete a successful watershed protection or restoration project. (202) 833-8317.

Environmental Partnerships: A Field Guide for Nonprofit Organizations and Community Interests. Management Institute for Environment and Business. Available from the Management Institute for Environment and Business at (202) 833-6556.

How to Save A River: A Handbook for Citizen Action. Contains information on forming a watershed group, developing an outreach campaign and identifying problems that rivers face. River Network. Contact River Network at (202) 364-2550.

Know Your Watershed Campaign. CTIC. A series of fact sheets designed for people who want to organize a local partnership to protect their watershed. Contact CTIC at (765) 494-9555.

Little Nescopeck Creek-Jeddo Tunnel Rivers Conservation Planning Project List of Partners. Wildlands Conservancy. Listing of project partners includes members from several groups, including: colleges and universities, citizens' groups, conservation organizations, government, and private industry.

Outreach

Getting the Word in the Fight to Save the Earth. Richard Beamish. This book provides tips on communicating with your members to keep them involved, designing outreach materials, and fundraising strategies. Available from Johns Hopkins University Press, 2715 North Charles Street, Baltimore, MD 21218-4319.

How To Handbook (Draft). U.S. Environmental Protection Agency. A guide for developing materials, developing your message, and identifying appropriate communication channels.

Incorporation

Starting Up. River Network. It contains information on developing a mission statement, recruiting a board of directors, fundraising, creating a budget, working with the media, producing a newsletter, as well as tips on using the watershed protection approach for river conservation. The handbook is $25 for non-members and $10 for members. The River Network's eastern office is located at 4000 Albemarle Street, N.W., Suite 303, Washington, DC 20016, phone: (202) 364-2550. Their internet home page can be found at: http://www.teleport.com/~rivernet/index.htm

Step 3: Assessing the Watershed

In This Chapter...

- Targeting Problems
- Conducting a Background Search
- Investigating the Watershed
- Field Assessment Tools and Procedures
- Conducting the Watershed Assessment
- Resource Information

TARGETING PROBLEMS

After you have established your watershed partnership and have begun the important task of publicizing your efforts and educating the public, the data gathering begins. Your group will be organizing a detective force to gather all available information on the watershed drainage area by reviewing maps, mining records, and other documents; talking to local people who are familiar with the specific mines; and conducting watershed assessments. Collecting existing and new information on the watershed drainage area is very important. Identification and characterization of CMD problem sites will determine and prioritize where clean-up projects will be conducted.

Maps, mining records, and other documents can be obtained from OSM, state mining agencies, state geological surveys, county clerks and property assessors, local historians, residents, archives, libraries, or sometimes from former employees. Much of the existing information and data pertaining to natural resources is organized by

Sources of Background Information

- *County clerk offices*
- *State water quality agencies*
- *State geological surveys*
- *Local conservation districts*
- *Libraries*
- *Universities*
- *Private consultants and industry*
- *Federal agencies*

  U.S. Environmental Protection Agency

  Office of Surface Mining

  U.S. Geological Survey

  U.S. Army Corps of Engineers

  U.S. Fish and Wildlife Service

  U.S. Department of Agriculture

Since a good deal of information is often available from agencies, it is very important to contact them early in the process.

counties, states, and school districts. State water quality agencies prepare Water Quality Inventory Reports every two years, as required by Congress under Section 305(b) of the Clean Water Act. These reports contain data on stream monitoring, physical evaluations, problem areas, and other important information.

CONDUCTING A BACKGROUND SEARCH

Background information is helpful in determining where old mines are, what practices were used and who owns the land. Some early mining information may not be recorded, but most mining companies kept documents and maps of their activities. Since a good deal of information is often available from agencies, it is very important to contact them early in the process. The advice and guidance of agency staff are vital to the work of watershed partnerships, and the motivation and energy of the partnership contribute to the work of the agency. Many times, citizens are surprised to learn that their creek or river has been monitored extensively by an agency or university research team. The summarized results of that data can provide valuable information for newspaper, radio or television coverage of the problem. Be advised, however, that sometimes data are old. Take precautions to check the dates of any data or other information provided, since water quality conditions change over time.

INVESTIGATING THE WATERSHED

After you have collected background information on your watershed, you will probably want to get out in the field and take water quality measurements to determine if there are areas impacted by CMD discharges. The following section provides an overview the tools commonly used in stream assessments, instructions on l to delineate a watershed, and recommendations for selecting sam

MILL CREEK

Information from the U.S. Army Corps of Engineers, PA Department of Environmental Protection, and Clarion University faculty and students led to the identification of 18 CMD discharges along a ten-mile stretch of Little Mill Creek. Fifteen of the discharges were the result of surface mining, with the other three stemming from abandoned gas wells. The flow rates and chemical characteristics of each discharge varied, but the general ranges were as follows: flow rate of 10-50 gallons per minute (gpm); acidity 250-500 parts per million (ppm); iron 50-250 ppm; aluminum 0-7 ppm; manganese 1-15 ppm; and sulfates 1000-1600 ppm.

pling sites. References to obtain more detailed information on stream assessments is provided in the Resource Information section.

Collecting Data

Even though previous data on water quality in your project area might exist and should be used, it can be useful to collect site-specific data on water quality conditions as part of your background search. More comprehensive data collection will be needed when conducting the watershed assessment as discussed in the next section.

Consider asking an area college or water quality/mining agency to come out for a day to run some basic tests. College professors who teach biology, chemistry, geology, hydrology, or environmental science often welcome the opportunity to take their students on a field trip, where they can use their testing and lab equipment in a "real world" situation. Students who are interested in pursuing a career in the sciences are always looking for projects to work on for their future resumes, and many professors like to conduct research projects for eventual publication.

High school science teachers and students likewise can be valuable assets to your project. Many high schools have lab facilities and some can conduct fairly sophisticated water quality tests in the field. Involving these local teachers and students often results in the recruitment of interested parents who staff agencies, businesses, factories, and civic groups that can become partners in your project.

Do It Yourself!

If you are unable to interest a university or high school in testing the water, consider doing it yourself. Many grassroots groups and watershed partnerships—such as the Isaak Walton League—have members who have at least some college chemistry and/or biology training and are more than capable of gathering baseline information on flow rates, fish habitat conditions, acidity, and other parameters. Check to see if there is a volunteer monitoring program in your watershed. These programs are usually staffed by trained nonprofessional citizen members who are usually well-organized and operate under rigorous quality control guidelines. Many of the organizations take water quality samples and assess stream and lake conditions on a periodic basis.

The Stoneycreek-Conemaugh River Improvement Project (SCRIP) developed a CMD monitoring program using trained volunteers and university students with considerable success.

The Field Crew

The watershed assessment will most likely involve a host of volunteers. A lot of people who attend your meetings want to do something—they aren't happy sitting around talking about organizational issues, funding research, or deciding who is going to be on the communications committee. Many of them will find their niche through the field work aspect of the project. There is a lot of work involved, but it is rewarding, interesting and often enjoyable.

Proper organization, supervision, and management of field work is absolutely essential if your findings are going to be used as the basis for a clean-up program. It is important to obtain professional help when defining and conducting the actual data collection process. If you have water quality or mining agency people in your partnership who are willing to handle the field assessment, let them. Agency personnel can sometimes train field volunteers, supervise them, and manage the investigation. In addition, established environmental organizations such as the *River Network* and the *Izaak Walton League*, etc. may be able to provide training. For more information on these different organizations, refer to the Resource Information section at the end of this chapter.

Potential Volunteers Are Everywhere

University and high school students

Members of local environmental organizations

Scout troops

Teen clubs

Civic groups

Retired persons

Training field volunteers

Field volunteers require some basic training in using the sampling tools, interpreting the different color conditions of the stream, and identifying bugs that could be potential indicators of CMD. It will also be important for volunteers to learn the proper use of topographic maps, pH testers, and conductivity meters. Ideally, many of your volunteers will be somewhat knowledgeable about the work they will be doing. Make every attempt to pair up an experienced assessor with inexperienced volunteers for the best results.

It is a good idea to recruit water quality agency staff, university personnel, or watershed organization members to conduct the training. Hopefully, you will have some of these people within your partnership and can interest them in coordinating training for the field staff.

Field Assessment Tools

Maps are excellent reference and planning documents, but when it comes to pinpointing CMD sources, the best method is to find the sites in the field, locate them on a topographic map, take water quality samples, estimate volume or discharge amounts, and enter the information into your database.

Topographic Maps

Before you conduct your watershed assessment, you will need to obtain topographical maps. "Topo" maps show the "lay of the land" with their detailed contour markings, making it easy to identify hills, ridges, waterways, roads, and other features. Each map measures about 18 x 20 inches and covers an area of about 7 miles by 8.5 miles. The production dates of these maps vary across the country, so be sure to note when your maps were printed. If they are very old, be alert for possible differences in road routes, buildings, and other features.

Two types of maps should be used to assess the watershed: a county highway map and a U.S. Geological Survey (USGS) 7.5-minute topographical map. The county highway map provides a detailed layout of roads, creeks, and other landmarks of the area and is useful for finding general regions to be investigated. The USGS topographical maps are used to delineate watershed boundaries and to identify sources of water, drainage ditches, creeks, rivers, some mine sites, structures, power lines, pipelines, ponds, and other features.

Testing Equipment

Basic test kits for pH can be purchased from any national firm for less than $75, with some of the color comparator pH kits priced in the $30 range. The best pH testers are the newer microprocessor-based units, which fit easily in a shirt pocket and can detect changes down to one-tenth or even one-hundredth of a pH standard unit. They cost $45 to $100, and display readings on a small digital screen. A pocket-sized conductivity meter is another good investment for field testing and is used to measure the amount of dissolved metals found in water samples. Conductivity refers to the ability of an electric current to pass through the water more quickly due to the presence of dissolved solids.

If you decide to do the testing yourself, it is a good idea to involve professionally trained partners, agency staff, or volunteers so that the readings are taken in the right places at the right times, and good records are kept of the sampling stations and results.

Bug Cards

In addition to visual observations, an effective water quality assessment tool for field volunteers is a simple pictorial key to stream insects and crustaceans. The Izaak Walton League of America publishes an excellent "bug card" printed on both sides of a notebook-sized sheet of poster board. The organisms on the key are grouped according to their pollution tolerance.

Field Assessment Procedures

Ask Permission

Make sure your assessors have landowners' permission before they work on private property. Landowner information is available

Typical Watershed Assessment Parameters

- *Water quality measurements (pH, dissolved oxygen, biological oxygen demand (BOD), conductivity, metals)*
- *Flow*
- *Visual observations*
- *Biology*

Tools of the Trade

- *Topographic and county map*
- *Compass*
- *Clipboard, pen, and paper*
- *File folders in which to collect information on each site*
- *pH tester*
- *Flow measurement devices*
- *Camera*
- *Macroinvertebrate keys*
- *Pocket-sized electrical conductivity meter*

from county clerks, property assessors, neighbors and other knowledgeable local people. This also allows the collection of information from each landowner, who can often direct field volunteers to sites that require investigation. Interest and support from landowners will be needed if treatment needs to occur on their property.

Safety First

Since some field sites will be remote, field workers should make sure that other people know exactly where they are going and when they expect to return. Investigators should always travel in pairs and should be in fairly good health for the physically demanding task they will be performing. If water samples are to be taken downstream from houses with questionable septic systems, plastic or rubber gloves, antiseptic towelettes, and a hepatitis shot are advisable. Make sure volunteers are advised to never drink water from streams, springs or other untreated sources in the field. Drinking water from a reliable source should be brought into the field in canteens or jugs.

Keep Your Data Organized

As information becomes available from these and other sources, it will be important to keep it organized. Subdividing the watershed into smaller units (subwatersheds, or the drainage areas of smaller feeder streams) will allow for easy processing and storage of information. Chart information collected on maps, labeled with file numbers of pertinent information at specific sites. For example, a map for the Mill Creek subwatershed might pinpoint a site as "CMD Source #12," which would correspond with a file folder (Mill Creek #12) which contains documented site information and water test results for that particular location. Organizing your watershed assessment in this manner will help to keep all your information in an easy-to-use format.

Oven Run

A resource inventory found six sites of significant CMD discharges from deep mine openings, stripping and erosion of land downhill from CMD discharges, erosion in spoil areas, seepage of CMD into streams, and infiltration of CMD-ponded water into the ground water. These six sites were chosen for treatment due to potential public health and safety risks, the high acidic content of the water, and the destruction of aquatic life in many sections of Stoneycreek River. The main public health concern focused on the Borough of Hooversville, which has a drinking water intake pipe in Stoneycreek River two miles downstream from the CMD sites.

CONDUCTING THE WATERSHED ASSESSMENT

Delineate Your Watershed

Prior to conducting your field assessment, you must first delineate the boundaries of your watershed on a topographic map. See **Appendix C** for step-by-step instructions to watershed delineation. Marking off watershed boundaries on a USGS "topo" map is easy once you understand how the contour lines correspond to the elevation (above sea level) of the land. In delineating watersheds and subwatersheds, the trick is to use the contour map to find the ridges that separate watershed drainage areas. Establishing all the high points surrounding a drainage area will provide a "connect-the-dots" outline of the watershed boundary.

Visual Survey of the Watershed

After delineating the watershed boundaries and any subwatersheds, volunteers will conduct a visual survey of the area to identify major geographic features, land use activities, and other characteristics. Locate any piles of coal or coal waste, particularly if obvious contaminated CMD is flowing from them. Investigators should record the location of coal strata, or areas where pieces of coal are exposed on the ground surface. Maps should locate any CMD seeps, abandoned houses or towns, old buildings and mining equipment, abandoned railroad tracks or ties, and disturbed areas where water is standing.

Establish Sampling Sites

The volunteers' job is to methodically cover the tract assigned, which is a portion of the subwatershed along and above a stream with verified CMD problems. CMD-affected streams can be identified by sampling water quality at selected points. Sampling sites should be selected carefully, since they will provide baseline and post-project data that will help to determine how effective the clean-up effort has been.

In general, a primary sampling site is situated at the lowest elevation of the target watershed, where the stream or river exits the project area. Other sites are located along the main stem of this waterway (3 to 6 sites, or more if necessary) and at the mouth of each feeder stream that empties into the main stem. (Note: Be sure to take mouth samples well upstream from where the feeder stream empties into the main stem, since some mixing of main stem and feeder stream water normally occurs at the point of confluence). Other sampling sites can be located up from the mouth of the feeder streams if they are large and contain areas of possible CMD. Of course, if a feeder stream mouth sampling site does not appear to be

Clues to Contaminated CMD

1. Contaminated Colors

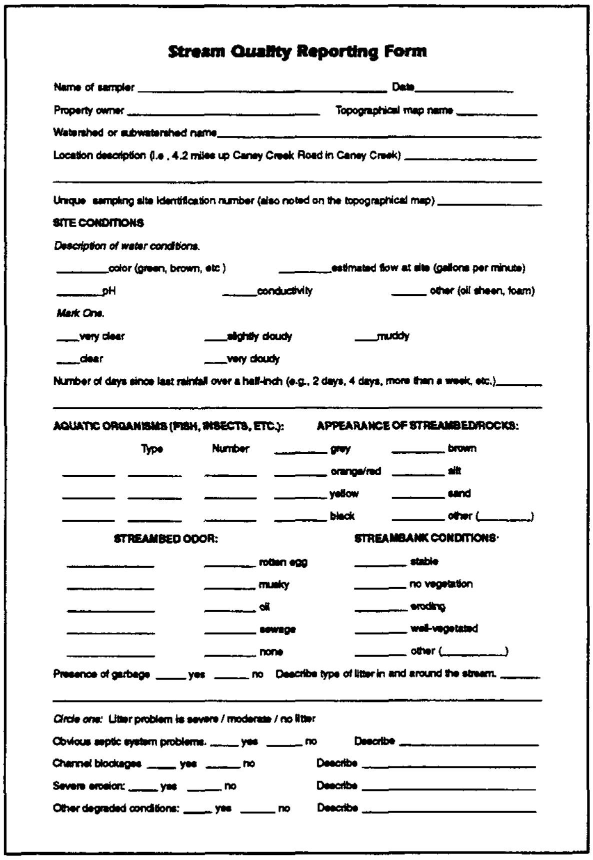
Red, rusty-colored stream banks and bottoms indicate the presence of iron; white deposits indicate the presence of aluminum; and black deposits indicate the presence of manganese.

2. No Bugs

The absence of aquatic organisms like stonefly and mayfly nymphs, hellgrammites (go-devils), crawdads, caddisfly nymphs, and other insect larvae and crustaceans that usually live among and under the rocks in clean streams.

3. Toxic Readings

Readings on color comparators or pH testers below the 6.0 range can be good indicators of CMD as well. (Note: Normal rainwater has a pH of around 5.6 and lower in some parts of Appalachia due to acid rain, so avoid testing right after significant rainfall.) If you also measure conductivity, readings above 800 generally indicate the presence of dissolved metals and probable CMD. However, a conductance of 800 or greater is frequently obtained in areas where bicarbonate, sodium, and chlorides are high. Highly alkaline groundwater discharge from aquifers can also cause such a reading.



Stream Quality Reporting Form

Name of sampler ______________________ Date ____________

Property owner ____________________ Topographical map name ____________

Watershed or subwatershed name ______________________________

Location description (i.e . 4.2 miles up Caney Creek Road in Caney Creek) ____________

____

Unique sampling site identification number (also noted on the topographical map) ____________

SITE CONDITIONS

Description of water conditions.

______color (green, brown, etc) ______estimated flow at site (gallons per minute)

______pH ______conductivity ______ other (oil sheen, foam)

Mark One.

____very clear ____slightly cloudy ____muddy

____clear ____very cloudy

Number of days since last rainfall over a half-inch (e.g., 2 days, 4 days, more than a week, etc.)______

____

AQUATIC ORGANISMS (FISH, INSECTS, ETC.): APPEARANCE OF STREAMBED/ROCKS:

Type Number ______ grey ______ brown

______ ______ ______ ______ orange/red ______ silt

______ ______ ______ ______ yellow ______ sand

______ ______ ______ ______ black ______ other (______)

STREAMBED ODOR: STREAMBANK CONDITIONS·

__________ ______ rotten egg ______ stable

__________ ______ musky ______ no vegetation

__________ ______ oil ______ eroding

__________ ______ sewage ______ well-vegetated

__________ ______ none ______ other (______)

Presence of garbage _____ yes _____ no Describe type of litter in and around the stream. ______

____

Circle one: Litter problem is severe / moderate / no litter

Obvious septic system problems. _____ yes _____ no Describe ______________

Channel blockages _____ yes _____ no Describe ______________

Severe erosion: _____ yes _____ no Describe ______________

Other degraded conditions: _____ yes _____ no Describe ______________

affected by CMD, it is usually not necessary to establish upstream sampling points.

Identify CMD Discharges

While in the field, volunteers should take water quality samples, conduct a visual survey of the stream, record flow measurements, and note the presence of any aquatic organisms. If they find indications of CMD, they should look first along the stream channel and feeder creeks and ravines for signs of CMD sources.

Recording CMD Observations

If these signs are present, the field crew should attempt to determine whether the CMD discharge is coming from the stream bank area or even from the bed of the stream itself. This can be difficult to determine because the discharge can range from a field of small seeps to a running or even gushing flow. If the crew suspects a discharge along the bank or from the bed, they can take pH readings just above and below the suspected discharge area to see if there is a significant change (1.0 or greater difference in pH readings, or significant differences in conductivity readings).

As suspected CMD discharges are located, they should be pinpointed on the map and assigned a unique subwatershed name and identification number, as noted in the previous section. Readings on pH, color observations, insect and crustacean information, approximate discharge rates (in estimated gallons per minute), noticeable odors, and other pertinent information should be written in ink on a site assessment form and placed in a file folder. Be sure the volunteers label each form or sheet with a number that corresponds to the number designated on the topo map! Photo or video documentation of the sites should be made whenever possible.

A stream water quality reporting form is included in **Appendix D** for you to photocopy and use on your assessments.

Remember Pre-law vs. Post-law Discharges

Some of the CMD discharges might be resulting from post-SMCRA operations. If so, regulators will want to initiate an investigation quickly so contact your state water quality and mining regulatory agency as soon as possible.

Report Contaminated CMD Discharges

It is important if your field team finds a contaminated CMD site (i.e., low pH, absence of aquatic organisms, stained water, etc.), to locate it on a map, and notify state water quality and mine regulatory agencies immediately. These agency officials can then check whether or not it is an active, or post-SMCRA discharge, and take appropriate action. If not, they can also enter this information into their abandoned mine land database. Having these agency people in your partnership will ensure that this task is accomplished and that further investigation can begin in a timely manner.

RESOURCE INFORMATION

Macroinvertebrate Keys

The Izaak Walton League of America (IWLA) publishes an excellent "bug card" printed on both sides of a notebook-sized sheet of poster board. IWLA can be reached a (800) BUG-IWLA.

Topographic Maps

USGS maps are available at the geology departments of major state universities, local or county planning commission offices, sporting goods stores, or directly from the USGS (phone: (703) 648-6892; address: USGS, Reston, VA 22092).

Field Assessment

The Art and Science of Mine Drainage Prediction (paper). Hyman, D.M., J.W. Hawkins, R.L.P. Kleinmann, and G.R. Watzlaf. 1995. Attachment to letter from William J. Kovacic, Field Office Director, OSM Lexington Office, to Carl Campbell, Commissioner, Kentucky Dept. for Surface Mining, Frankfort, KY, November 29, 1995.

The Strip Mining Handbook: A Coalfield Citizen's Guide to Using the Law to Fight Back. The Environmental Policy Institute. Chapter 9 provides information on monitoring a strip mine. Contact the Institute at (202) 544-2600.

A Stream Watcher's Stream Guide. Izaak Walton League of America. Summarizes indicators of pollution in flowing waters.

Streamwalk Manual. U.S. Environmental Protection Agency, Region 10, 1994. The manual is designed to be an easy-to-use screening tool for monitoring stream corridor health. EPA 910-B-94-002.

The Volunteer Monitoring Guidance on Stream Surveys (Draft). U.S. Environmental Protection Agency. The manual will be finalized soon and will include detailed information on conducting streamside surveys.

Water Quality Testing Kits

A few of the firms that have testing equipment catalogues available are:

Forestry Supplies, Inc.	(800) 752-8460
HACH Company	(800) 227-4224
International Reforestation Supply	(800) 321-1037
LaMotte Company	(800) 344-3100
Wards Natural Science Establishment	(800) 962-2660
Wildlife Supply Co.	(517) 799-8100

Volunteer Monitoring

Save Our Streams. The Izaak Walton League of America has volunteer training materials through its Save Our Streams program. Contact IWLA at 707 Conservation Lane, Gaithersburg, MD 20878-2983, or call (800) BUG-IWLA.

The Volunteer Monitor's Guide to Quality Assurance Project Plans. U.S. Environmental Protection Agency. This document outlines the procedures a monitoring program will use to ensure that the samples collected and analyzed are of high quality. Contact the Volunteer Monitoring Coordinator at (202) 260-7018.

The Volunteer Monitor. A periodic newsletter that covers issues like the organization and management of volunteer monitoring programs, training, testing methodologies, planning approaches, and other themes. Subscriptions are available by contacting Eleanor Ely at 1318 Masonic Avenue, San Francisco, CA 94117 or by calling (415) 255-8049.

Step 4: Understanding Clean-Up Options

In This Chapter...

- Targeting Clean-Up Sites
- Overview of Treatment Approaches
- Reclamation and Remediation
- Resource Information

TARGETING CLEAN-UP SITES

Understanding the various CMD treatment methodologies will help you understand the engineering portion of your project. A brief overview of these approaches appears below. More details on treatment methods are included in **Appendix E.** These systems involve assessment, design, and construction assistance from qualified professionals and are presented here only in summary form.

OVERVIEW OF TREATMENT APPROACHES

Assessing CMD sites for possible construction of treatment systems involves analyzing four basic criteria: water chemistry, flow rate, available land, and financial/in-kind resources.

Treatment methods to address CMD focus on neutralizing, isolating, stabilizing and/or removing problem pollutants through various chemical, physical and biological processes. There are two basic types of treatment systems. Active treatment involves the addition of alkaline chemicals such as lime, soda ash, or ammonia, with the contaminated drainage to decrease its acidity and speed up the removal of metals. Passive systems clean contaminants from mine drainage by exposing it to air, limestone, cattails and other vegetation that form carefully designed components of ponds, neutralization ditches, buried channels, and wetlands.

Technical and Economic Factors to Consider for Active Treatment Systems

Technical factors include the acidity level of the discharge, rate of flow, types and concentration of metals in the water, rate and degree of pH increase desired, and the solubility of the chemicals in the water.

Economic factors include cost of the reagents, handling costs (labor, machinery, and equipment), and the number of years that treatment will be needed.

Active Treatment Systems

Active CMD treatment uses strong alkaline chemicals such as lime, caustic soda, ammonia, and calcium oxide to neutralize acid so that metals can be precipitated and removed. Active treatment systems are classified by the chemical used to treat the CMD.

There are six chemical reagents which are typically mixed with contaminated mine drainage in active systems. Each chemical has characteristics that make it more or less appropriate for a specific condition. The best choice among the alternatives depends on both technical and economic factors.

- Limestone (calcium carbonate)
- Hydrated Lime (calcium hydroxide)
- Pebble Quick Lime (calcium oxide)
- Soda Ash Briquettes (sodium carbonate)
- Caustic Soda (sodium hydroxide)
- Ammonia (anhydrous ammonia)

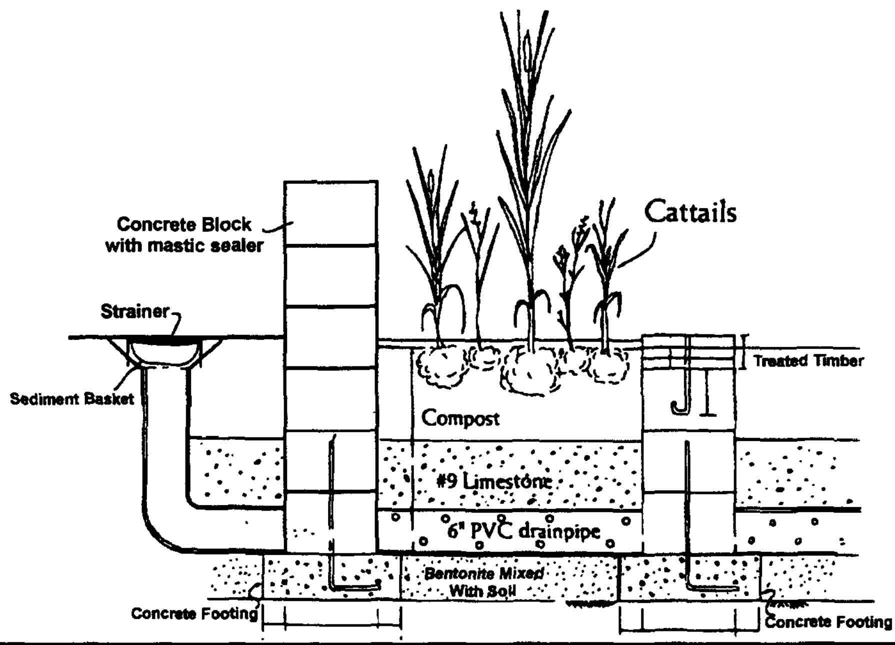
Mill Creek

The CMD treatment methodology chosen involved the use of anoxic limestone drains (ALDs) which fed constructed anaerobic wetlands. In the fall of 1991, the Howe Bridge Site treatment system was constructed to treat two adjacent CMD discharges. The flow rate of the two discharges was between 30 and 40 gallons per minute (gpm), which loaded 100 to 125 pounds of iron and acidic water (pH = 3.0) into Mill Creek each day. Damariscotta Environmental Consultants designed the system, and the 876th Engineer Battalion of National Guard Company B, stationed at Punxsutawney in Jefferson County, built it. Documented performance of the system included the removal of 90 to 95 percent of the iron, and a 300-fold increase in pH (from a pH of 3.0 to a reading of 6.0).

The National Guard built two more systems in 1992, improving the water quality of the discharges to the same standards as the first treatment system. The three systems eliminated high levels of iron and low (acidic) pH readings from the discharges that entered Mill Creek for a distance of six miles. In 1994, a system was built for Little Mill Creek to clean up the last six miles of the main stem of Mill Creek.

Cross Section of Passive Treatment System

(from University of Kentucky, Department of Agronomy)



Passive Treatment Systems

Passive systems remove or neutralize contaminants in mine drainage by exposing them to air, limestone, vegetation in ponds, neutralization ditches, buried channels, and wetlands. Exposing CMD to air helps to precipitate metals through oxidation processes; limestone contact neutralizes acid by adding alkalinity; vegetation such as cattails filter contaminants and aid in oxidation and metals removal; and organic wetlands remove metals and provide habitat for bacteria that break down sulfates.

Since passive systems are designed to make use of gravity flow through ponds, buried channels, ditches and wetlands, they can treat CMD without the continual addition of chemicals or neutralizing agents. In general, ponds are used to collect mine drainage, settle out larger particles of sediment, oxidize metals, and can reduce acidity when underlain with organic material and limestone. Ditches convey drainage to ponds or wetland cells, and often contain crushed limestone rock for acid reduction. Wetlands serve a variety of treatment functions, including filtration of smaller sediment particles, uptake of water and some contaminants, oxidation/adsorption of metals, and removal of sulfates through bacterial action.

Aerobic wetlands

Aerobic wetlands are used for low-acid CMD to collect flows, settle out sediments and provide residence time so that metals in the water can precipitate. Cattails and other wetland vegetation are

Constructed aerobic wetlands typically consist of:

- *A basin having a natural or constructed low-permeability barrier of soil;*
- *Synthetic liner material to minimize seepage;*
- *Substrate (soil or another suitable growing medium), placed over the barrier to support and nourish vegetation; and*
- *Wetland plants such as cattails and other planted or emergent vegetation.*

Cooperation between your partnership, regulatory agency personnel, private contractors, funding sources, and elected officials will be vitally important during the design and construction phase of your clean-up plan.

planted in an aerobic wetlands substrate to promote the uptake of water and small quantities of metals and other contaminants.

Anaerobic wetlands

These wetlands are used to treat CMD that is higher in acidity or sulfate concentrations. Anaerobic wetlands are similar to aerobic wetlands in appearance; however, they are underlain with an organic muck (substrate) and a layer of limestone.

Anoxic Limestone Drains (ALDs)

ALDs are buried trenches or channels containing crushed limestone into which acidic CMD is channeled. As the CMD flows through, the limestone is dissolved, alkalinity is added and pH is increased. The channels are covered to reduce or eliminate the presence of oxygen; the elimination of oxygen prevents the development of an iron oxide coating (armor) on the limestone.

Alkalinity Producing Systems (APS or SAPS, Successive Alkalinity Producing Systems)

APS or SAPS combine the use of ALDs and anaerobic wetlands. Elevated dissolved oxygen concentrations are often a design limitation for ALDs. If dissolved oxygen concentrations are above 1 or 2 mg/l, the water can be collected in a pond underlain with drainage pipes which are covered by limestone and capped off with organic material.

Limestone Ponds (LSPs)

LSPs are a new passive treatment approach in which a pond is constructed on the upwelling of an AMD seep or underground water discharge point. Limestone is placed in the bottom of the pond and the contaminated water flows upward through the neutralizing limestone.

Reverse Alkalinity Producing Systems (RAPS)

RAPS are similar to limestone ponds in design and installation, but are more efficient in removing metals.

Open Limestone Channels (OLCs)

OLCs can be used to increase alkalinity and reduce acid, but armoring reactions promoted by contact with the air will reduce their effectiveness somewhat.

Oven Run

Plans for CMD treatment in the watershed include the use of rock-lined channels to divert CMD surface water, and a combination of alkalinity producing systems, settling ponds, and wetlands using composted mushroom spoil and cattails.

During construction, erosion and sediment control practices will be applied, and existing areas of erosion and infiltration to ground water will be addressed

Design Considerations for Passive and Active Systems

Trenches, wetlands, and ponds of treatment systems must be designed to handle the CMD flow and predicted rainfall. These constructed devices should be impermeable to prevent seepage of the CMD into the ground, where it can bypass the remainder of the treatment system and contaminate ground water. Linings can be clay or grassed if the flow is not excessive. If the flow is considerable, rip-rap (large rocks that do not contain acid-producing material) can be used to slow the flow, or other nondegradable, nonerodible material like plastic liners can be used. Sometimes check dams made of rip-rap or straw bales are installed to reduce the velocity of CMD flows through channels or ditches, and they must be designed and constructed to ensure containment of the flow plus predicted rainfall.

Side slopes of ponds, wetlands and other embankments must be designed and constructed to prevent slippage and erosion, which usually involves establishing a thick stand of grass. Kentucky Bluegrass, tall fescue, reed canarygrass and Bermuda grass make excellent vegetative covers for embankments and ditch features.

RECLAMATION AND REMEDIATION

Sometimes it is possible to prevent the formation of contaminated drainage at abandoned mine sites through reclamation, remining or other remediation approaches. This option removes the need for treatment, which is often expensive, labor intensive and long-term.

Capping

One common preventive approach involves capping mine wastes with a layer of impermeable clay to restrict rainwater percolation and formation of CMD. If a field investigation determines that rain water is flowing into underground mine works through identifiable openings at the surface, it is advisable to fill and/or seal the openings to prevent CMD. Remediation can also include re-directing streams to reduce contact with contaminant sources like coal waste piles.

Remining

In other cases, there is still recoverable coal in the vicinity of contaminated mine drainage. Before CMD sites are scheduled for expensive treatment system construction, it may be worthwhile to have a geologist determine whether enough coal is present at the site to justify remining. Some old mines were worked before the development of modern equipment, so it is possible that significant coal reserves are still present. The remining contractors would apply for permits that would ensure that their operations prevent the generation of CMD by careful planning, engineering and operational approaches to the remining work.

RESOURCE INFORMATION

Treatment Technologies

(**Appendix** E of this guide includes detailed descriptions and limitations on various treatment technologies for CMD.)

Development of New Technologies for the Utilization of Municipal Sewage Sludge on Surface Mined Lands. Final Report. Haering, K.C. and W.L. Daniels. October 1, 1991. Department of Crop and Soil Environmental Sciences, Virginia Polytechnic Institute and State University. Report investigates new technologies that revolve around using sewage sludge mixtures as a soil type to support plant growth on coal refuse piles for stabilization.

Kentucky Coal Mining Practice Guidelines for Water Quality Management, Kentucky Division of Water and University of Kentucky Agronomy Dept.; Natural Resources and Environmental Protection Cabinet, Commonwealth of Kentucky; March, 1996.

Lime Substitutes for the Treatment of Acid Mine Drainage. Heunisch, G.W. 1987. Mining Engineering. pp. 33-36. Two new lime substitutes for treating AMD were tested and compared. Sludge settling rates are faster with the new lime substitutes than those obtained using real lime.

Managing Environmental Problems at Inactive and Abandoned Metals Mine Sites, U.S. Environmental Protection Agency Office of Research and Development, EPA 625-R-95-007.

Passive Treatment of Coal Mine Drainage, U.S. Department of the Interior, Bureau of Mines Information Circular 9389, 1994.

Practices for Protecting and Enhancing Fish and Wildlife on Coal Surface-Mined Land in Central and Southern Appalachia. U.S. Fish and Wildlife Service. 1983. FWS/OBS-83/08. Information on best current practices (BCPs) to protect and enhance fish and wildlife resources on surface-mined land in central and southern Appalachia.

Renovation of a Failed Constructed Wetland Treating High Metal Load Acid Mine Drainage in the Rock Creek Watershed. Barton, C.D., and A.D. Karathanasis. 1996. In 1996 Kentucky Nonpoint Source Pollution Conference Proceedings, Kentucky Division of Water, September 1996.

Revegetation and Minesoil Development of Coal Refuse Amended with Sewage Sludge and Limestone. Joost, R.E., R.J. Olsen, and J.H. Jones. 1987. Journal of Environmental Quality. 16(1)65-68. Study in So. Illinois found that the use of dried sewage sludge and/or limestone to ameliorate acid coal refuse for establishment and survival of three forage grasses is indeed effective.

Statement of Mutual Intent Strategic Plan for Restoration and Protection of Streams and Watersheds Polluted by Acid Mine Drainage from Abandoned Coal Mines: 1995 Progress Report. U.S. Environmental Protection Agency and the U.S. Department of the Interior. Discusses current mine drainage control activities in VA, PA, WV, MD, and OH, as well as future CMD activities.

Step 5: Establishing a Clean-Up Plan

In This Chapter...

- Establishing Priorities
- Setting Goals and Objectives
- Developing a Plan of Action
- Resource Information

ESTABLISHING PRIORITIES

After your group has completed an assessment of the watershed, identified potential CMD discharge sites, and reviewed the basic treatment methodologies, a plan should be developed to address the highest-priority problems. During this phase of your project, it will be most important to involve the technical professionals, agency personnel, and volunteer monitors who will be dealing with the prioritization, design, funding, installation, maintenance, and monitoring of the treatment method selected.

Form a Committee

The work undertaken during this phase is usually managed by a special committee, with regular reporting to watershed partnership members on progress.

This technical committee will ideally involve representatives from mining and water quality agencies, soil and water conservation programs, university research institutions, environmental protection agencies, private engineering firms, landowners, public officials, and citizens. In deciding how to proceed, the committee will review results of the monitoring program, the nature and amount of available funds and other resources, space requirements for selected site treatment systems, and landowners' willingness to participate.

Define Clean-Up Parameters

The process of identifying where and what type of treatment approaches to use is highly subjective. Water chemistry, flow, available space, and financial resources will determine the nature of the remediation projects approved for construction. Since water quality and flow are two primary considerations in the deliberations, the importance of a well-designed, well-executed monitoring and assessment program (see Step 3) cannot be overstated. Monitoring groups will provide the data to professional staff and agency representatives involved in the remediation design that will dictate the path of much of the clean-up program.

The following section describes the process for determining the desired outcomes for each watershed and subwatershed, and how these activities affect the goals that have been established.

Mill Creek

There were six main factors that influenced the group's decision to clean up Mill Creek.

- *Even though Mill Creek was heavily polluted, the group felt the watershed could be improved. If a clean-up attempt was not made, Mill Creek would continue to deteriorate.*
- *Previous studies on CMD within the watershed had already been conducted and documented by U.S. Army Corps of Engineers and the PA Department of Environmental Protection.*
- *The watershed included both Jefferson and Clarion Counties, which brought to the table each county's NRCS office, Conservation District, and Resource Conservation and Development District organizations. The involvement of two counties was also advantageous for financial support considerations.*
- *The lower half of Mill Creek's main stem included a public access recreational area known as PA Game Commission Game Lands Unit #74. This region had a high potential for a recreational cold-water fishery.*
- *Future strip mining was not a concern since most of the watershed had been previously mined and the quality of the remaining coal was low.*
- *Mill Creek is easily accessible for both Clarion and Jefferson residents.*

Set Priorities

Regional watersheds contain multiple subwatersheds, which have unique attributes, problems, and uses. Federal and state agencies define surface waters as high-quality outstanding resource waters (such as Wild and Scenic Rivers); primary contact recreational waters (swimmable), secondary contact waters (fishable); domestic water supply sources (drinking water sources), cold water aquatic habitat (trout-quality streams), and warm water aquatic habitat (a catch-all category for nondesignated waters). States usually designate their waterways as serving one or more of these uses. If a water body does not support its designated use, it is said to be use-impaired and is often targeted for remediation.

After investigating the uses, quality, characteristics, and relationships that each water resource has within the watershed, individual goals for subwatersheds can be established. These goals usually depend on existing and future desired uses, so consideration should be given to public health concerns, drinking water quality, recreational uses, and aesthetic quality, among other criteria. In selecting a watershed for a clean-up project, pick a site that is doable. Tackling an extremely polluted site that is beyond the capabilities of the partnership and the resources available might lead to failure and frustration. Clean up smaller areas first, then move on to bigger ones; it will give your partnership valuable experience and the motivation that comes from executing successful projects.

A goal for your CMD-impacted waterway might be to lower the levels of acidity and metals to the standards required for designation of your stream as cold water aquatic habitat. When considering long-term goals for the watershed, partnership members should widen the scope of their assessment to include problems stemming from nonmining sources.

SETTING GOALS AND OBJECTIVES

In setting goals for your watershed and subwatersheds, it is vital to work with the state water quality personnel within your partnership. These agencies collect and maintain records on most water bodies within the state, which are forwarded to Congress every two years as part of the state's requirements under the Clean Water Act. A close alliance with public agencies during all phases of your project will pay dividends by having the project at least considered in the agency's official documentation and goal-setting processes.

Determining the goals and desired condition of water resources, however, is increasingly left to the discretion of citizens and other stakeholders in the watershed. Under the watershed protection approach being implemented by state and federal agencies, regional watershed partnerships are charged with the authority and responsibility for developing criteria for the desired quality of water resources in their regions. Through this process, partnership members set goals for the watershed (fishery support, recreational use, aesthetic beauty, etc.) and then identify factors that prevent attainment of the goals. Problem factors are then assessed, and plans are developed to address them.

Use your goals and objectives as guidance for the project, but do not become so obsessed with them that you become inflexible. Unforeseen circumstances abound in any project. Maintain a clear sense of ultimate purpose (cleaning up the watershed) and perception to help your group recognize future challenges and opportunities when they emerge and make it easier to deal with them. Establish a process for revising components of the objectives as necessary to make the work proceed with minimal disruption.

Start with a "Vision"

A "visioning" process is often employed to establish goals for the watershed. Partnership members bring unique perspectives and desires to the partnership, and the melding of these diverse outlooks and aspirations into an achievable plan provides the sense of ownership stakeholders need to stay involved over the long term. From the vision synthesized by the partnership, long- and short-term goals can be established and plans to reach those goals can be developed. When considering long-term goals for the watershed, partnership members should widen the scope of their assessment to include problems stemming from nonmining sources. Erosion, failed or nonexistent onsite sewage treatment systems, nutrient runoff, and other nonpoint and point sources of pollution often contribute significantly to water quality problems in Appalachian watersheds. Developing a comprehensive watershed plan involves identifying all contaminants and developing strategies to deal with them.

DEVELOP A PLAN OF ACTION

By addressing your prioritized CMD problems through a step-by-step approach, you can create a sense of steady progress toward achieving the goals of your partnership. Start by assigning each task group or committee a section of the work plan and ask them to determine the following:

- a group leader
- a start-up date
- actions to complete (objectives)
- a completion date
- any obstacles they can predict that might slow the process down
- strategies to address those obstacles, and a plan for reporting regularly to the entire partnership group

It is important to keep the public informed on your progress through regular news releases, media tours, brochures, public meetings, and other outreach methods.

Develop a Schedule

Although there is no simple solution for turning your plans into action, having a master schedule will help organize your tasks. The comprehensive schedule should include budgeting information, funding and technical assistance sources and mechanisms, individual and task group assignments, and critical deadlines for negotiations and actions.

Partnership members need to understand their roles in the partnership work plan, be willing to give their time and effort, be honest and open-minded, and accept the various setbacks, pressures, and frustrations that will arise. Patience and persistence will be required from those involved, especially the leaders of the group. It is important for your partnership members to recognize that the task they are undertaking represents a significant challenge. The problems of CMD were not created in a year or two, and it is unlikely that the watershed will be cleaned up in that period of time.

Choosing Group Leaders

When choosing group leaders, consider each member's determination, dedication, reliability, and ability to articulate the goals of your partnership. It is important to have stable leaders who can keep the group focused and assist in solving disagreements. Good "people skills" are important for group leaders because they often have to deal with disagreements on strategy, work assignments or other issues. Technical know-how is helpful, but do not forget the human dimension of your work. Involving the maximum number of watershed partners will greatly add to the success of your project, so select leaders who act in an inclusive, mutually respectful manner.

Lead the Way...

The Pennsylvania Department of Environmental Protection reiterated the importance of watershed partnerships with strong leadership in the state's 1996 Comprehensive Plan for Abandoned Mine Reclamation (August 1996):

"Partnerships among public and private institutions are essential to accomplishing the goals of this comprehensive plan. Partnerships can develop at any phase of the planning process. The leadership role among the partners is the most important decision the partners make. The earlier partners establish a leader and define their individual roles, the more effective they will be. For the most part, leadership should lie with a local organization where there is strong, local support and a commitment to long-term solutions."

Assign Responsibilities

It is important to assign responsibilities for managing progress toward each objective, and to identify partnership members who will be involved. Watershed groups can proceed more quickly with their projects, as enthusiastic agency personnel, business people, citizens, industrial leaders, and elected officials involve themselves in the effort. This "snowball effect" can create tremendous momentum for your project, though with increasing velocity and mass (more people) come organizational, scheduling, and work assignment challenges. Diligence, mutual respect, and a strong commitment to participatory partnership decision-making processes will ensure that progress occurs as smoothly as possible and that all participants feel the sense of involvement and momentum that vitalize and enhance CMD clean-up efforts.

Organizing Takes Time

The SCRIP partnership in Pennsylvania spent 3 years organizing the watershed assessment, conducting field studies, and analyzing treatment options. Funding for some of their projects has come only recently, after several years of work.

Potential Roadblocks

A number of factors can affect the start date of your actions. Lack of funding and technical support, unresolved conflicts within the group, and communication gaps between funding and technical assistance participants and organizations are all examples of problems you might need to resolve before making firm dates to start work. Committee leaders will need to determine the actions required to complete specific sections of the master schedule, solicit volunteers to perform the tasks, and establish a completion date. These decisions should be reported to the partnership periodically to ensure that other possibly conflicting or mutually necessary activities can be coordinated. When organizing their work, those responsible for implementing objectives in the plan should define the roles of outside organizations and individuals and should devise a way to evaluate progress and ensure that alternative or backup plans exist.

Oven Run

On December 20, 1993, a letter of mutual support and cooperation for the restoration of Oven Run was signed by seven federal agencies, three state agencies, and five local organizations. The local NRCS office prepared a preliminary report on the watershed, and a resource plan was developed by the Northeast Regional Technical Center and local NRCS offices. The local NRCS is also designing the systems which will be used to clean up the CMD at the six selected sites in the project area.

Area Conservationist Jim Gettinger attributes the success of the project to three elements: a strong local emphasis, early involvement of agencies and other organizations, and the sense of ownership that comes from an inclusive approach.

RESOURCE INFORMATION

Clean Water in Your Watershed: A Citizen's Guide to Watershed Protection. Terrene Institute. 1993. Washington, DC. Guide designed to help citizen groups work with local, state, and federal government agencies to design and complete a successful watershed protection or restoration project.

Cleaning Up Contaminated Sediment: A Citizen's Guide. U.S. EPA. Jan. 1995. Prepared for the U.S. EPA/GLNPO by the Lake Michigan Federation. This guide has a section devoted to public involvement in the clean-up of contaminated sediment.

Environmental Partnerships: A Field Guide for Nonprofit Organizations and Community Interests. Management Institute for Environment and Business. 1995. To order, call 800/782-4479.

Environmental Planning for Small Communities: A Guide for Local Decision-Makers. U.S. EPA. 1994. Designed to help leaders of small communities develop a community environmental plan that will save money, make the best use of resources, and meet all environmental regulations. Offers tips on how to build a partnership, develop a shared vision, and define community needs.

How to Do an Urban Streambank Cleanup. West Michigan Environmental Action Council. Describes the steps necessary to organize and carry out a stream cleanup.

Step 6: Financing and Implementing Your Plan

FINANCING YOUR PROJECT

A primary limitation to turning your plan into action will be the ability to fund your project. Numerous sources of funding and technical assistance are available to groups attempting watershed clean-up projects. The only problem is determining when, where, and how to begin a search. See **Appendix F** for a matrix of possible funding sources for CMD projects.

Do Your Homework

Research funding sources early, and during each stage of your project. Identify potential funding sources before you develop your financial and action plans. It will not only simplify your search, but allow you more time to widen its scope. If you have not previously established a base of funding sources, consider contacting several watershed associations with completed CMD projects. This information will provide you with sources of financial support and additional funding ideas.

In This Chapter...

- Financing Your Project
- Funding Sources
- Maintaining Your Effort
- Resource Information

Start With Your Partnership

All members of your partnership should be involved in funding efforts to demonstrate their commitment.

When researching each prospective funding source, find out:

- Who have they funded in the past? Are these efforts consistent or in conflict with your proposed projects?
- How important is your project to their giving program? To their mission?
- What is their timetable for grant giving?
- Who is the project officer to whom you should direct your funding inquiry?

MILL CREEK

Funding and support for the Mill Creek projects have come from watershed coalition members and other organizations. The following table displays the sources that were involved and their contributions. Other contributors included Seneca Rocks Audubon Society, Clarion County and Jefferson County Federation of Sportsmen, Strattanville Sportsmen's Club, Clarion Fraternal Order of Eagles, Clarion County League of Women Voters, Alliance for Wetlands and Wildlife, Magic Forest of West-Central Pennsylvania, and USDA NRCS.

Mill Creek Watershed Coalition Funding Partners

Organization	Contribution
Local banks (various)	*$100 to $2,500*
Clarion University, C.U. Foundation	*2-3 student workers*
PA Higher Ed. Assistance Authority	*40% of students' wages*
Iron Furnace Chapter, Trout Unlimited	*$9,000*
Trout Unlimited state and national organizations	*$23,000*
Regional Trust	*$20,000*
PA DER OSM and coal companies	*$14,000 (4 times/2years)*
Damariscotta Environmental Consultants	*In-kind professional services*
NRCS	*In-kind professional services*
Conservation Districts	*In-kind administrative and support services*
PA Game Commission	*Land Use permission for treatment*
PA National Guard	*$85,000 in construction services*
PA DER Bureau of Oil and Gas	*$158,000 - plug 3 wells (CWA 319 $)*
RC&D and NRCS	*$165,000 for AMD sites (CWA 319 $)*
McLean Contributorship	*$20,000*
Vera Heinz Foundation	*$40,000*

Timing Is Everything

To secure funding, timing is essential. It is important to determine the time needed to create an effective application, including information-gathering, writing and rewriting, and internal review time. Getting an early start on funding will ensure that you do not miss critical funding deadlines. It is often helpful to include elected officials, community and business leaders, and agency representatives on your fundraising committee, since they often have excellent contacts within both public and private funding organizations.

Note Any Special Requirements

As you research funding sources, be sure to note the requirements for applying, especially the type of organizational entity necessary for receiving an award. These requirements will have a direct bearing on how your application is structured, what organization will actually be submitting the application, and who will be responsible for financial management, reporting, and programmatic activity.

Parties responsible for reporting and handling management tasks need to agree up front what their duties will be. A memorandum of agreement should be drawn up to list responsibilities, if a number of separate organizations are involved.

Increase Your Chances for Getting Funding

Most applications for funding are direct requests for fairly specific activities. Projects that are:

- tightly focused,
- have widespread in-kind and other support,
- demonstrate considerable need,
- seem "doable,"
- appear well-structured, and
- adequately assessed

receive more consideration than those which lack these qualities. Defining your project through the goals established for the watershed helps focus projects that are developed for possible funding. In addition, letters of support from partnership member organizations, businesses, elected officials and other members show funding source representatives that your project has broad support.

Since CMD problems are formidable and funding is less than adequate, federal and state sources look for strong partnerships planning achievable projects when considering funding applications. The amount of support that a project has determines its ultimate success. Outreach and education are the keys to promoting involvement within the watershed community and sparking the interest of

What Do States Look for in Funding Applications?

Pennsylvania's approach to funding considerations is instructive. State reviewers rate proposals according to the following criteria:

- *The potential for water quality improvement in the watershed*
- *The potential for a state/federal/local partnership*
- *The existence of funding from other sources*
- *The potential for remining at the site*

potential funding sources for CMD remediation projects. People need to know what CMD is, how it affects them and their local economy, the approaches involved in treating CMD, and what is necessary to implement the project. Support will be needed from citizens, government, industry, businesses, and other organizations to provide the expertise, resources, and funding required for success.

FUNDING SOURCES

Funding from local and external sources and in-kind support from your regional partnership partners will be essential elements in achieving the overall goals established for your watershed.

In addition to support from your partnership members and other local and regional entities, funds for CMD remediation are available from private foundations and several governmental agencies. Each of these sources of support has its own criteria for applying for funds, and each has unique project management and reporting requirements. Due to the importance of financial support to the overall success of your effort, it is usually necessary to establish a special fund-raising committee early in the process. As potential funding sources are identified, they need to be updated regularly on how your field work and watershed analysis are progressing. This effort requires a personal touch. People on the fund-raising committee should be appointed to work with each potential funding source as the project unfolds. This approach generates interest among potential financial supporters and cultivates the relationships that are essential in acquiring the resources that will be needed during the treatment system's design and installation phase.

Where to Look for Funding

Potential sources of funding can be found in all sectors. As always, begin by looking locally. A brainstorming session among partnership members is a good way to jog people's memories regarding their networks. A contact inside an organization can often link you quickly with the appropriate person. The more prospects you can identify, the better the chances of finding the financing necessary to move your project forward. Funding can be obtained primarily from two major sources:

- the private sector, which includes foundations, not-for-profit organizations, corporations, and local businesses; and
- the public sector, which includes federal, state and local agencies.

Private Sector Funding

While researching possible funding sources, do not forget about the local business and industrial community, not-for-profit organizations, and foundations. Many contractors who depend upon public work projects like roads and bridges are very interested in supporting efforts that benefit the economy of the region, as are business people and representatives of area industries.

Foundations: Foundations must give away at least five percent of their assets each year to retain their foundation status. Typically, foundations have a board of directors that review proposals for funding. There are national directories that describe the eligibility requirements, funding cycles, and contact names for more information on foundations. See the Resource Information section at the end of Step 6.

Not-for-profit Organizations: Try teaming up with various environmental organizations, professional societies, universities, and associations to obtain financial or in-kind support for your CMD clean-up project. If they cannot provide direct funding, they may be able to provide technical assistance, or other in-kind services.

Corporations: Many corporations have community relations offices that support local projects. You may have already enlisted support from the community when forming your partnership. Check out your local businesses and banks to see if they provide any funding support. Remember that in-kind services can be just as valuable for your project.

Mining Industry: Sometimes mining companies and local or regional contractors will offer to provide in-kind services like heavy equipment work to construct treatment system components, and some mining firms might be interested in remining some problem areas, if the approach is feasible.

Public Agency Funding

Federal, state, and local agency funding for CMD clean-up projects comes from a variety of sources. These sources include federal agencies such as the U.S. Environmental Protection Agency, the Office of Surface Mining, the National Resource Conservation Service, and the U.S. Army Corps of Engineers, as well as from individual state program offices. Keep in mind that your CMD project may be eligible for funding from program areas such as watershed restoration, sediment and erosion control, nonpoint source pollution control, or source watershed protection.

The Abandoned Mine Lands (AML) Program: The AML program was established by Title IV of SMCRA. Under this program, coal operators now pay a 35-cent fee for each ton of surface-mined coal removed, and 15 cents for each ton of

Public Agency Funding Examples

The federal Abandoned Mine Lands (AML) program has funded projects in West Virginia, Pennsylvania, and other states.

Nonpoint source pollution remediation support from the Clean Water Act Section 319 program provided $480,000 for monitoring and remediation projects on Bear Creek in Tennessee.

The state of West Virginia received nearly $1 million of a 1997 Appalachian Clean Streams Initiative (ACSI) allocation to OSM targeted at CMD clean-up.

Pennsylvania spent $75 million in special bond issue money in the 1960s to address some of the state's most pressing mine-related problems.

deep-mined coal. These funds go to the Abandoned Mine Reclamation Fund (AMRF), which is administered by the OSM. However, the amount actually provided to projects each year depends on the allocation approved by Congress. While some of the funds are targeted at emergency AML problems like mine fires, landslides threatening homes, and dangerous subsidence conditions, most AMRF monies are potentially available for contaminated CMD clean-up. States may set aside 10 percent of their allocated AML funds in interest-bearing accounts to address CMD problems.

The Appalachian Clean Streams Initiative: A primary focus of the ACSI is to improve the efficiency of public fund use in cleaning up CMD by helping to coordinate information exchange and eliminating duplication of effort among federal, state, and local agencies and private groups. Congress appropriated $4 million for 13 ACSI projects in FY 1997, including $975,000 for projects in West Virginia, $325,000 for the Quemahoning Creek cleanup in Pennsylvania, $100,000 for Cherry Creek in Maryland, $650,000 for projects in Ohio, and $325,000 for the Little Toby Creek project in Pennsylvania. Watershed groups seeking to address CMD problems should contact their state ACSI representative for technical assistance and possible funding. See **Appendix G** for more information on funding opportunities under ACSI.

EPA Coal Mine Drainage Initiative: EPA's Region 3 office has several programs which can provide funds for restoration of abandoned coal mine drainage impacted watersheds. These include the Nonpoint Source Program under Section 319 of the Clean Water Act, Regional Geographic Initiatives Program, Environmental Education, and Environmental Justice. A more detailed explanation and point of contact for these and other EPA funding programs is listed in

How much is enough?

While it seems that adequate funding might be available to address CMD problems, such is not the case. Pennsylvania, which has received an annual allocation of about $20 million in AML funds recently, has an estimated $5 billion in abandoned mine CMD problems. That state alone has about 2,400 miles of CMD-contaminated streams, 250,000 acres of unreclaimed surface mine land, and potential subsidence problems on hundreds of thousands of acres.

OVEN RUN

CMD treatment expenses and sources of funds for the Oven Run Project

	NRCS PL 83-566 Funds	*Other Sources*	*Total Funds*
Construction	*2,189,000*	*2,189,000*	*4,378,000*
Engineering	*438,000*	*0*	*438,000*
Project Administration	*280,000*	*73,000*	*353,000*
Land Rights	*0*	*18,000*	*18,000*
Total Funds	*2,907,000*	*2,280,000*	*5,187,000*

Appendix F. EPA also has on its homepage the Guidebook of Financial Tools which provides an overview of the various ways/ means to fund sustainable environmental systems. The web site address is: **http://www.epa.gov/efinpage/guidebk/guindex.htm.**

MAINTAINING YOUR EFFORT

By this point, you should have a good idea of how to organize your project, educate the public, assess your watershed, analyze clean-up options, prioritize remediation projects, seek funding support, and begin work. As your project unfolds, remember that you're in this for the long haul. Once the clean-up work has begun, it will be necessary to monitor both the installed treatment systems and the quality of the water they were designed to improve. Developing post-clean-up monitoring plans for the installations and the water bodies involved will ensure that you can quickly identify any problems with the treatment systems, and specifically measure the success of your efforts. Establishing your volunteer water monitoring program as a permanent part of environmental oversight in your watershed creates long-term interest in the quality of your rivers and streams and makes it easy to identify future problems as they arise.

Stewardship essentially begins with monitoring, since analyzing water quality provides information on how waterways are affected by land uses upstream. Recognizing that the monitoring program will serve as a focal point for long-term activities of the partnership is a vital component of watershed protection.

Share Your Experiences

As members of your partnership gain experience with project activities, consider offering outreach support to newer groups. Watershed protection partnerships are being developed across the region to deal with CMD and other pollutants, and your members can provide valuable assistance to their efforts. The experience your group has developed can help others avoid common pitfalls and provide clear direction for their efforts. Linking your group with statewide partnerships, including volunteer monitoring programs, builds strong regional organizations and helps to develop competent local affiliates as information and experience are shared.

Report your results of the assessment and clean-up from your efforts to watershed association meetings, technical meetings, state and federal water quality agencies, and scientific literature.

Check How You Are Doing

Use the checklist on the next page to track your efforts for cleaning up CMD sites. Make a copy of it to use over and over.

Checklist for Cleaning up your CMD-impacted Watershed

- ☐ 1. Develop a watershed partnership that includes involved and affected parties to establish long-term goals, identify problems, assess problems, set priorities, correct deficiencies, and monitor results between January and April.

- ☐ 2. Research existing data on water quality, mining activity, and other possible sources of contamination during February through May.

- ☐ 3. Identify the specifications (pH, metal concentrations, etc.) for designation as cold water aquatic habitat and develop water monitoring program during April through June.

- ☐ 4. Conduct field surveys, water testing and research to determine the levels of problem parameters at various points in the watershed and subwatersheds during June through September.

- ☐ 5. Identify the segments of the affected waterways that appear to have the most significant levels of the problem parameters between August and October.

- ☐ 6. Conduct comprehensive, site-specific follow-up field surveys to confirm earlier field results at the most significant sites during October and November.

- ☐ 7. Assess the relative contributions of the problem sites to water quality deficiencies in the overall watershed between December of Year 1 and February of Year 2.

- ☐ 8. Prioritize the problem sites according to their impact on water quality between March and May of Year 2.

- ☐ 9. Assess remediation options for each site representing the most significant problems during May through August of Year 2.

- ☐ 10. Analyze costs of each proposed remediation project and identify possible funding sources between August and December of Year 2.

- ☐ 11. Develop funding proposals for the selected remediation projects during August of Year 2 through March of Year 3.

- ☐ 12. Secure funding, contact installation contractors, and implement remediation projects during March through September of Year 3.

- ☐ 13. Assess the water quality impacts of the remediation projects through the comprehensive water monitoring program both before and after remediation projects are installed.

- ☐ 14. Conduct a vigorous program of public outreach and education throughout the entire project period.

RESOURCE INFORMATION

Appalachian Clean Streams Initiative can be reached at (412) 937-2106, or by writing ACSI, through James Taitt, OSM, 3 Parkway Center, Pittsburgh, PA 15220.

The Clean Streams Contact List is a network of persons with a common goal of cleaning and restoring streams. Users can find community support, funding information, technical information, and much more by contacting the people on the contact list. The list can be obtained through The Clean Streams Clearinghouse.

The Foundation Center is an independent national service organization established to be an authoritative source of information on private philanthropic giving. It has a nationwide network of cooperating collections, available to the public free of charge. The core collection includes *The Foundation Directory*, The Grantsmanship Center publishes a "Whole Nonprofit Catalog" and provides grantsmanship training. It publishes several useful publications on grant seeking including *Program Planning and Proposal Writing.* Call (800) 424-9836 to inquire about the nearest collection.

1997 Directory of Funding Sources for Grassroots River and Watershed Groups. Available for $35. Contact River Network, (800) 423-6747 or email rivernet2@aol.com.

Pennsylvania's Abandoned Mines: Problems and Solutions. PA DER, 1993. Pamphlet discusses Pennsylvania's reclamation program and projects, as well as funding sources for mine reclamation and its benefits.

River Fundraising Alert. A series of ten newsletters on memberships, special events and appeals, board fundraising, and major donors. Contact River Network, (800) 423-6747 or email rivernet2@aol.com.

The Taft Group publishes directories of funding sources, such as the *Taft Corporate Giving Directory*, and management materials. For a catalogue, call (800) 877-TAFT.

Ten Percent Set Aside for Acid Mine Drainage Abatement. PA DEP Fact Sheet. 1996. Describes the AMD abatement and treatment fund managed by the Bureau of Abandoned Mine Reclamation in the DEP. Funds are available to qualified hydrologic units affected by past coal mining practices at eligible sites. Eligible sites are defined as those where mining ceased prior to August 3, 1977 and where no continuing reclamation responsibility can be determined.

Appendix A: Glossary of Terms

Acidic: a condition where the concentration of positively-charged hydrogen ions is high, and the pH is less than 7.0.

Aeration: the process of mixing air into a solution so as to allow atmospheric gases to dissolve into the solution through direct contact, stirring, forced injection, or other means.

Aerobic: a condition existing or process conducted in the presence of oxygen.

Alkalinity: a measure of the ability of a solution to absorb positively-charged hydrogen ions without a significant change in pH. Also referred to as buffering capacity. Alkaline solutions have a pH greater than 7.0.

Aluminum: a common metal element found in CMD that oxidizes as a whitish powder at high pH levels.

Anaerobic: a condition existing or process conducted in the absence of oxygen.

Anoxic: a condition existing or process conducted in the absence of oxygen; anaerobic.

Anoxic limestone drains (ALDs): sealed pipes or ditches containing crushed limestone used to neutralize the acid in CMD.

Appalachian Clean Streams Initiative: a program sponsored by OSM to coordinate and focus CMD clean-up projects in the United States.

Basic: a condition where the concentration of negatively-charged hydroxide ions is high, and the pH is greater than 7.0; alkaline.

Contaminated coal mine drainage: mine runoff or discharge water containing abnormal acid or alkalinity levels, elevated sulfate and metal concentrations, and silt or other suspended solids.

Dissolved oxygen: the amount of oxygen (O_2) that is dissolved in a solution. Dissolved oxygen (D.O.) can cause armoring on limestone by oxidizing iron compounds in CMD to form iron hydroxide. D.O. is usually measured in parts per million (milligrams per liter).

Dissolved solids: compounds in a solution that can be precipitated through chemical processes into solids.

Effluent: the solution that flows out of a basin, pond, tank, wetland, ditch, pipe or other containment.

Environmental Protection Agency: the federal agency created by executive order in 1970 to coordinate efforts to protect human health and biological communities from environmental pollutants.

Ferric hydroxide: an iron compound that forms when dissolved iron in CMD is oxidized, and appears as a rusty, reddish-orange residue. It is often called yellow-boy.

Flow rate: the rate a solution moves through a ditch, wetland or pond, defined in terms of the quantity of CMD per unit of time (i.e., 500 gallons per hour, etc.).

Hydrolysis: a reaction that occurs when a salt dissolves in water and leads to changes in the H_3O^+ and OH^- concentrations of the water.

Hydroxide: a compound containing the OH^- molecule.

Iron: a common metal element contained in mine rocks in the form of iron sulfide that oxidizes as a reddish, rusty colored hydroxide solid.

Leach: migration of atoms or compounds from mine rocks or other substances through the action of water, acid or other solvent.

Manganese: a metal element found in CMD that oxidizes as a blackish stain.

Metal: elements that are solids (except mercury), have few electrons in the outermost shell, and lose electrons easily to form cations. Metals of concern in CMD include iron, aluminum, manganese and sometimes lead, mercury, copper, and zinc.

Neutral: a condition where the concentration of hydrogen ions [H^+] equals the concentration of hydroxide ions [OH^-], resulting in a solution that is neither acidic or basic (alkaline) and has a pH value of 7.0 standard units. Distilled water is a neutral liquid.

Neutralize: to cause a solution to move toward a pH reading of 7.0 standard units through chemical or biological processes.

Office of Surface Mining: the federal agency charged with enforcing SMCRA and dealing with health, safety and resource protection issues related to active mining and abandoned mine problems.

Overburden: the layers of rock and soil found above coal bed deposits. Overburden rocks often contain acid-forming materials in the form of iron sulfide and other compounds that can form dissolved metals and sulfates in CMD.

Oxic: a condition where atmospheric, gaseous oxygen is present.

Oxidation: a reaction in which a substance losses electrons. In the case of CMD metals oxidation, the oxidizing agent is gaseous oxygen. Metal oxides are formed in the process.

Permeability: a measure of the rate of water movement through soil or other substance.

pH: a value, expressed in standard units on a scale of 0-14, that uses a logarithmic measure to express concentrations of hydrogen ions [H^+]. pH readings below 7.0 are said to be acidic, and readings above 7.0 are basic, or alkaline. Each unit difference represents a ten-fold increase or decrease in acidity or alkalinity.

Precipitate: an insoluble, solid product that is formed when ions combine with atoms or molecules in the air or with other atoms or compounds in a solution. Also, the process of dissolved compounds becoming solidified.

Porosity: the ratio of the volume of voids (openings) to the total volume of material. Used to describe the ability of a fluid to move through crushed rocks or other material.

Pyrite: the iron-sulfide mineral, often called "fools gold," that is found in earthen and rock layers near coal seams. Pyrite is the usual source of the sulfur that binds with hydrogen and oxygen in rain water to form the sulfuric acid component of CMD.

Reduction: a reaction in which a substance gains electrons. In CMD treatment, reduction usually involves the stripping away of oxygen atoms from sulfate or metal compounds.

Residence time: the length of time that CMD remains in a treatment pond, wetland, ditch or other structure. Designed residence times depend on the incoming flow rate, the rate of treatment processes in the structure, the contaminants in the CMD to be treated, the size of the structure, and the settling rate of solids in the discharge.

Sedimentation: the process whereby particles (suspended solids) settle out of solution. Sedimentation produces a sludge or other layer of solids at the bottom of a sedimentation, or settling, pond.

Settling Basin: a large tank or pond designed to hold water or CMD for a long enough time to allow most of the suspended solids to settle out (sedimentation).

Sludge: the layer of solids that settle from a solution, including suspended silt and soil particles and precipitates formed by chemical processes.

Solubility: the amount of material that can dissolve in a given amount of water or other solvent at a given temperature to produce a stable solution. Highly soluble substances dissolve quickly. Soluble products will not settle out of a solution unless they are precipitated.

Subsidence: the settling of waste piles or other areas at mine sites which causes the surface of the land to sink.

Substrate: the rich, organic layer of compost or other material found at the bottom of wetlands.

Subwatershed: the watershed of a tributary in a larger watershed.

Successive alkalinity producing systems (SAPs) - specialized CMD treatment ponds that make use of chemical and biological processes to treat the acid, metals and sulfates in CMD.

Sulfates: compounds containing sulfur and oxygen as SO_4. Elevated sulfate levels are common in contaminated mine drainage. Sulfates can bond with hydrogen ions to form sulfuric acid, or bind to calcium atoms to form a gypsum solid.

Surface Mining Control Act of 1977 (SMCRA): The federal law that requires mining operations to prevent water pollution, reclaim mine lands and protect other resources.

Suspended solids: solid particles that are suspended in solution. Suspended solids in CMD can include oxidized metals, silt or soil and other tiny debris particles.

Topographical map: a map that shows land elevations by use of lines that connect points of equal elevation (contour lines), water bodies, streams, buildings, mine sites, roads and other land features.

Watershed: an area of land from which water drains toward a single channel.

Appendix B: Federal Surface Mining Control and Reclamation Act (SMCRA) of 1977

While this guide deals with cleaning up contaminated coal mine drainage (CMD) at abandoned mines, it is appropriate to mention the role of prevention. Coal is still being mined in Appalachia and elsewhere, it is important to ensure that CMD problems at these sites are prevented. Citizens can be valuable partners to public agencies charged with the authority and responsibility for regulating mining activities. SMCRA allows citizens to monitor and become involved in permitting processes, thereby helping agency personnel and mine operators ensure that current and future operations are performed in an environmentally responsible manner.

The Provisions of SMCRA

- SMCRA regulates all ongoing (i.e., active) coal-mining operations in the United States, as well as the surface effects of underground mining. The law also applies to coal preparation and processing facilities, waste piles and loading operations located near mines. Mines that produce less than 250 tons of coal per year, recover coal as a secondary product, extract coal only for the operator's personal use, or function as part of a government-funded construction project are the only exceptions to SMCRA's provisions.

- Under SMCRA, an individual state can assume the role of primary regulator if it can prove its oversight programs are at least as comprehensive as those of the federal OSM. The law further requires that all operators obtain a permit from the state mining agency to extract coal. Permits must contain detailed information on the geological characteristics of the affected land, its ecology and hydrology, the operator's legal and financial status and history of compliance with mining laws, and plans for mining and final reclamation operations. If sample analyses are required, particular attention should be paid to geological analyses that characterize the acid-forming potential of each stratum of overburden. Samples analyzed should be spaced so that an accurate representation of the site is developed and the chemical analysis can be performed. Plans for handling potentially acidic, alkaline, or toxic waste materials must ensure that CMD will not be produced to the point where it condemns the operation to perpetual treatment.

- Regulatory agencies are required to certify that operators can fulfill their obligations under the law and successfully reclaim their sites before issuing permits. Bonding and insurance are also required to provide financial assurance that money will be available to correct any problems or cover any damages if an operator encounters financial difficulty or abandons the site. The importance of ensuring that adequate bonding and insurance provisions are included in mining permits cannot be overstated.

- SMCRA also requires operators to minimize disturbances to surface streams and groundwater systems, to restore approximate original contours of the land, and to reclaim the area upon completion of mining activities. Inspection and enforcement provisions focus on reducing threats to public health and the environment through the oversight of state and federal agencies. The law also designates some lands as unsuitable for mining, such as lands within the National Park System, near Wild and Scenic Rivers or the National System of Trails, and within 300 feet of occupied homes, churches, public buildings, and parks. All states can deny, and in fact, are obligated to deny any permit application that the respective state determines will result in material damage (acid damage).

Citizen Involvement Under SMCRA

Under the provisions of SMCRA, citizens have the right to accompany a mine inspector if a problem (violation or imminent harm situation is thought to exist) is alleged in writing and a request is made to participate in the inspection. Citizen groups in coal states have exercised their rights under the statute to ensure that mine operations, inspections, and reclamation work proceed in accordance with the best available practices to protect public health and the environment. Agency records on mine activity are available for citizen inspection under the federal Freedom of Information Act and corresponding state laws.

Preventing CMD formation at currently operating mines involves careful attention to mandated plans for managing the handling and/or disposal of overburden and other wastes. While ninety-five percent of all mine spoil does not contribute to water quality problems, federal permit regulations require operators to identify any acidic and other toxic-forming rock layers between the ground surface and the stratum just below the coal bed. Operators must engineer their mining plans to ensure that these problem materials are disposed of in a manner that prevents the formation of CMD. This can be accomplished through careful mixing of acid and alkaline materials; isolation of problem material through capping, burial, or runoff diversion; or application of chemical additives like lime to neutralize harmful by-products. Alkaline products such as flyash, kiln dust, alkaline recharge structures, etc., are also used. Groundwater diversions such as the use of highwall drains, and pit floor drains, are also used to control water movement through the site.

Additional Information on SMCRA

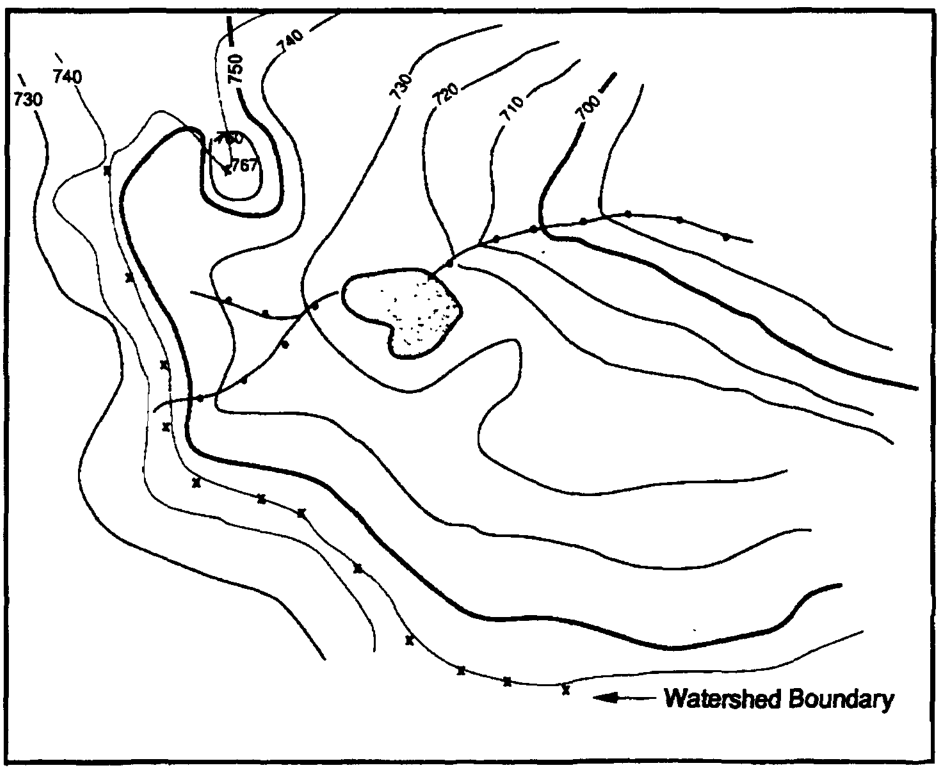
Additional information on SMCRA and related regulations is available from OSM, EPA, state mining agencies, and nongovernmental groups like the Citizens Coal Council and the National Mine Land Reclamation Center.

Appendix C: Watershed Delineation Instructions

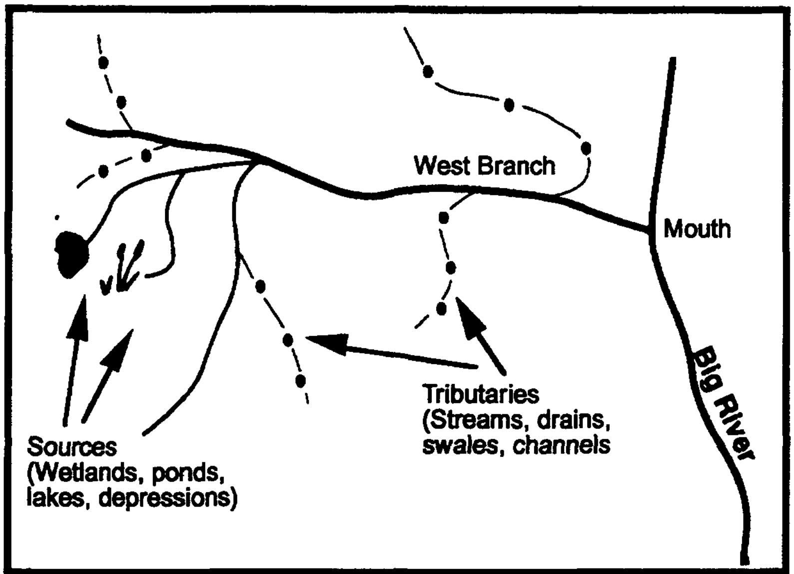
To pinpoint possible sources of CMD, you must first delineate the boundaries of your watershed on a topographic map. Topographic maps display physical features such as hills, valleys, ridges, and channels. Marking off watershed boundaries on a USGS "topo" map is easy once you understand how the contour lines corrpesond to the elevation of the land.

The following instructions outline how to delineate your watershed step-by-step. (Adapted from *Delineating Watersheds—A First Step Towards Effective Management*, U.S. EPA Region 5).

1) Use a topographic map(s) to locate the river, lake, stream, wetland, or other waterbodies of interest.

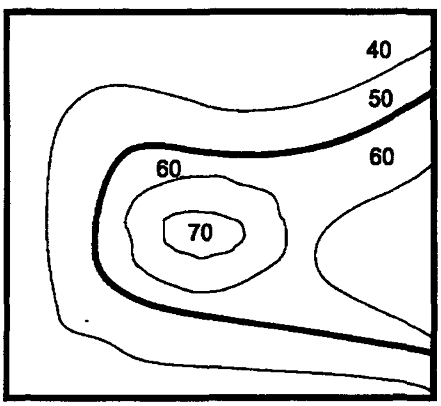


Topographic Map



2. Watershed boundaries

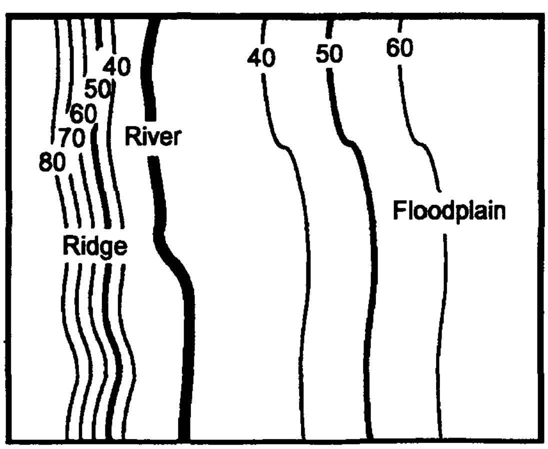
2) Trace the watercourse from its source to its mouth, including the tributaries. This step determines the general beginning and ending boundaries.



3. Contour Lines

3) Examine the brown lines on the topographic map that are near the watercourse. These are referred to as contour lines. Contour lines connect all points of equal elevation above or below a known reference elevation.

The dark brown contour lines (thick lines) will have a number associated with them, indicating the elevation. The light brown contour lines (thin lines) are usually mapped at 10 foot intervals, and the dark brown (thick) lines are usually mapped at 50 foot intervals. To determine the final elevation of your location, simply add or subtract theappropriate contour interval for every light brown (thin) line, or the appropriate interval for every dark brown (thick) line.

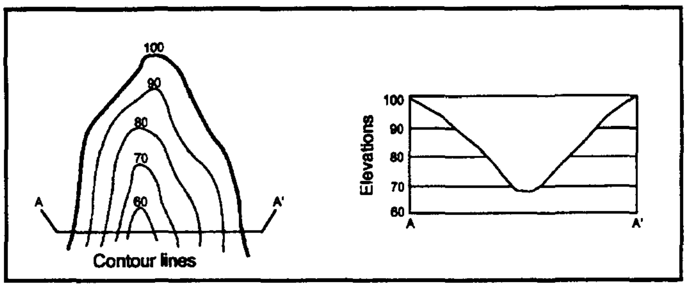


3. Contour Lines

Contour lines spaced far apart indicate that the landscape is more level and gently sloping. Contour lines spaced very close together indicate dramatic changes (rise or fall) in elevation over a short distance.

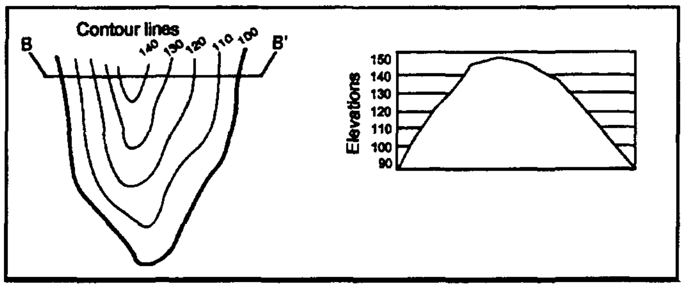
4) Check the slope of the landscape by locating two adjacent contour lines and determine their respective elevations. The slope is calculated as the change in elevation divided by the distance.

A depressed area (valley, ravine, swale) is represented by a series of contour lines "pointing" towards the highest elevation.



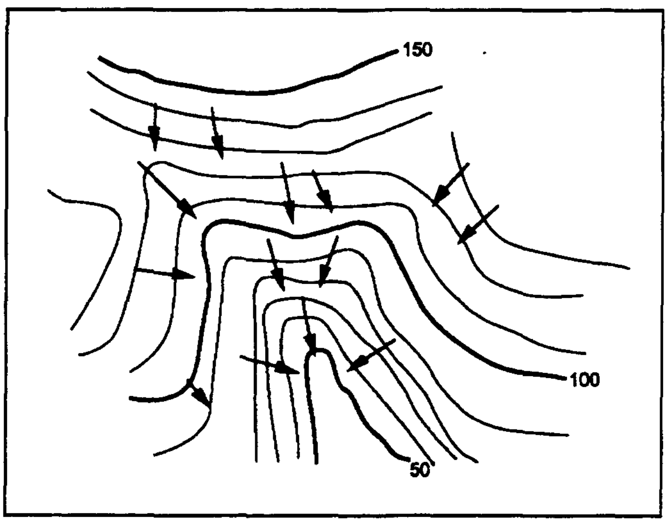
4. A depressed area

A higher area (ridge, hill) is represented by a series of contour lines "pointing" towards the lowest elevation.



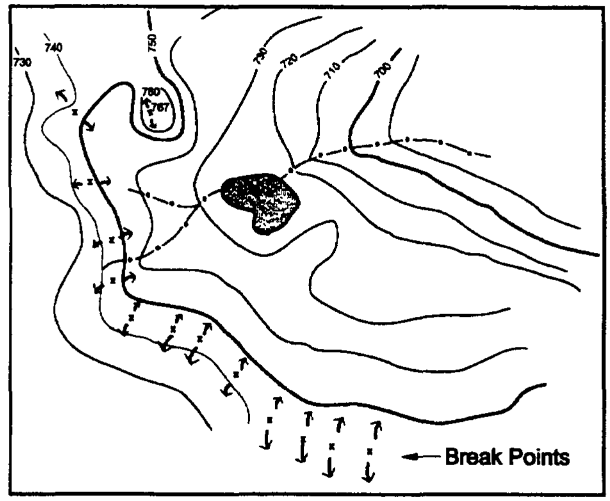
4. A ridge

5) Determine the direction of drainage in the area of the waterbody by drawing arrows perpendicular to a series of contour lines that decrease in elevation. Runoff seeks the path of least resistance as it travels downslope. The "path" is the shortest distance between contours, hence a perpendicular route.



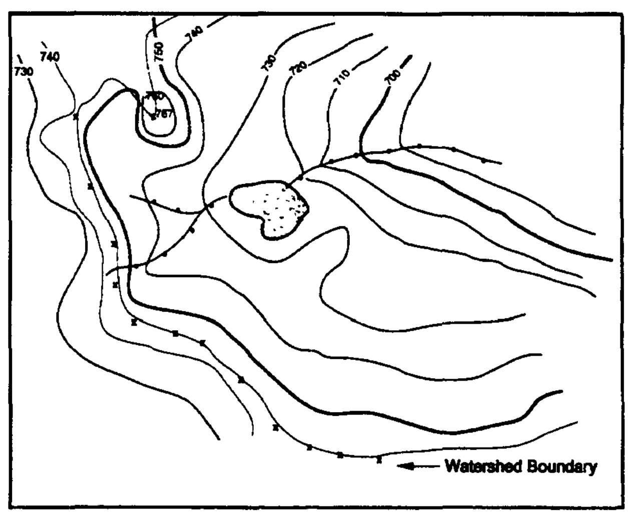
5. Direction of drainage

6) Mark the break points surrounding the waterbody. The "break points" are the highest elevations where half of the runoff would drain towards one body of water, and the other half would drain towards another body of water.



6. Mark break points

7) Connect the break points with a line following the highest elevations in the area. The completed line represents the boundary of the watershed.



7. Connect break points

Appendix D: Stream Quality Reporting Form

Stream Quality Reporting Form

Name of sampler ______________________________ Date____________

Property owner ______________________ Topographical map name __________

Watershed or subwatershed name____

Location description (i.e., 4.2 miles up Caney Creek Road in Caney Creek) ________________

____

Unique sampling site identification number (also noted on the topographical map) ____________

SITE CONDITIONS:

Description of water conditions:

______color (green, brown, etc.) ______estimated flow at site (gallons per minute)

______pH ______conductivity ______ other (oil sheen, foam)

Mark One:

____very clear ____slightly cloudy ____muddy

____clear ____very cloudy

Number of days since last rainfall over a half-inch (e.g., 2 days, 4 days, more than a week, etc.)______

____

AQUATIC ORGANISMS (FISH, INSECTS, ETC.):

	Type	Number
______	______	______
______	______	______
______	______	______

APPEARANCE OF STREAMBED/ROCKS:

______ grey ______ brown

______ orange/red ______ silt

______ yellow ______ sand

______ black ______ other (______)

STREAMBED ODOR:

______ rotten egg

______ musky

______ oil

______ sewage

______ none

STREAMBANK CONDITIONS:

______ stable

______ no vegetation

______ eroding

______ well-vegetated

______ other (______)

Presence of garbage: _____ yes ______ no Describe type of litter in and around the stream: ______

____

Circle one: Litter problem is severe / moderate / no litter.

Obvious septic system problems: _____ yes ______ no Describe ____________________

Channel blockages: _____ yes ______ no Describe ____________________

Severe erosion: _____ yes ______ no Describe ____________________

Other degraded conditions: _____ yes ______ no Describe ____________________

Appendix E: Treatment Technologies

PASSIVE TREATMENT SYSTEMS

Passive treatment is accomplished mostly through the action of bacteria, wetland plants, exposure to the air, and contact with limestone to neutralize acidity, break down sulfates and remove metals. Raising the pH reduces acidity, permits the survival of sulfate-reducing bacteria and promotes the oxidation and precipitation of dissolved metals in the drainage upon aeration. Metals can also be deposited directly as sulfide compounds into wetland sediments or bound up as plaque on plant roots. While wetlands are usually incorporated into multi-component treatment systems, they can be used as stand-alone treatment units if acidity is moderate, flows are low, and space is available.

The structural components of integrated passive CMD treatment systems require periodic maintenance but are relatively inexpensive. Some concerns have arisen over the expected life of wetland system components and long-term maintenance, and these factors must be explored and considered during the design phase. Removal of accumulated metallic sludges in wetlands and recharge of the organic substrate are primary maintenance considerations in designing and operating wetland systems. An excellent technical review of biological processes appears in *Passive Treatment of Coal Mine Drainage*, a document published by the U.S. Bureau of Mines (Information Circular 9389).

There are currently several passive treatment processes in use: aerobic wetlands, anaerobic wetlands, anoxic limestone drains, alkalinity producing systems, limestone ponds, reverse alkalinity producing systems, and open limestone channels. These approaches are often combined with other specially designed chemical and physical treatment processes to create a system capable of addressing a wide range of contaminants in CMD.

Some technical factors must be considered when deciding which passive method to use in the treatment of CMD:

- Amount of acidity and alkalinity in the CMD
- Flow rate of the discharge
- Types and concentrations of metals
- Solubility of the limestone (if used).

- Percent of calcium in the limestone (if used)
- Amount of dissolved oxygen in the CMD
- Oxidation/reduction potential of the CMD
- Amount of suspended solids in the CMD
- Hydrology of the watershed
- Space available

Limitations of Passive Treatment

Passive treatment has proven to be successful on small CMD discharges and some larger ones, but the long-term results are unknown. A considerable amount of research is being performed on this technology by agencies and universities throughout the coal states. Space is another primary limitation since constructed wetlands can require an area from several acres to several hundred acres in size. Other limiting factors involve the use of limestone in biological systems. Sulfate (SO4) at concentrations of approximately 2,000 mg/L will precipitate into an insoluble gypsum (CaSO4) sludge after reacting with the limestone (CaCO3). This may cause clogging in the pore spaces between the crushed limestone particles. Clogging can also occur if the velocity is not strong enough to move precipitating aluminum hydroxides out of the crushed limestone components. Finally, disposal of wetland sludges and replacement of the organic matter in the substrate are ongoing maintenance concerns.

Overview of Aerobic Wetlands

Aerobic (oxidizing) wetlands are man-made wetlands that provide an inexpensive and low-maintenance process for treating the metals contained in CMD with a pH above 6.0. The bed of the wetland is lined with plastic or rubber sheeting (or a layer of clay or other impermeable soil) to prevent seepage, and a top layer of rich soil or other organic substrate is added for the growth of vegetation and bacteria that help remove iron and manganese. Wetland plants such as cattails, reeds, rushes, and arrowhead are planted in the wetland to slow and filter the flow. Very little metal uptake by plants has been documented, though some uptake of heavy metals has been noted.

The primary processes of CMD treatment in aerobic wetlands are metal removal through aerobic bacterial activity and oxidation of metals through exposure of these dissolved metals to atmospheric oxygen. The large surface area of the wetland promotes the absorption of oxygen by the drainage water, facilitating the reaction that oxidizes and solidifies the dissolved metal compounds. Besides bacterial action and oxidation, metals are also removed in aerobic wetlands through the process of adsorption to substrate material and roots of the plants. An aeration device is sometimes used to further increase dissolved oxygen in CMD, especially alkaline discharges, which decreases the required residence or holding time in the cells.

Single aeration units can provide sufficient oxygen to oxidize 50 to 70 mg/L of ferrous iron; greater concentrations of iron require multiple aeration units.

After oxidation, the metals precipitate out of the CMD solution as a metal hydroxide sludge and settle to the bottom of the wetland. Metal precipitate sludges may fill and clog the aerobic wetland after a period of time to the extent that the system needs maintenance, reconstruction, or replacement. The process of oxidation increases the acidity of the CMD being treated, just as oxidation of mine wastes lowers pH and increases acidity. Neutralization of excess acidity at a subsequent treatment step may be required prior to final discharge.

Design Considerations for Aerobic Wetlands

The pH of the inflowing CMD must be between 6 and 8 for the system to work: metals that are being precipitated into a solid will redissolve if the pH starts dropping into the acid range (below 6). Even with ample oxygen, the oxidation of iron slows 100-fold with every unit decrease in the pH. Sufficient area must be available to construct an aerobic wetland with a flow path length and retention time that promote removal of the metals from the CMD. Other considerations in the design of constructed wetlands include site preparation, establishment of vegetation on wetland dike slopes, the number and size of wetland units (called "cells"), the type and thickness of earthen materials used in construction, water depth within the cells, flow patterns and rates within and between cells, discharge point locations, species of plants within the cells, control of animals like muskrats that may damage berms and dikes, and monitoring of discharged water. The Pennsylvania Department of Environmental Resources has published a document for constructed wetlands, *Approval of Constructed Wetlands for the Treatment of Mine Drainage,* that provides guidance on design and construction.

Limitations of Aerobic Wetlands

It should be noted that some states do not recognize the effectiveness of constructed aerobic wetlands as stand-alone units for treating CMD. These systems are not sufficient in and of themselves to acquire a mine bond release for active mining operations in states like Kentucky, and other states recognize that the methodology is new, relatively untested over the long term, and not effective under all conditions. Aerobic biological systems are designed to remove metals in CMD that has a relatively neutral pH (6.0 to 8.0), so pretreatment of the discharge through a chemical process is necessary for highly acidic or alkaline CMD. As noted previously, the oxidation process promote lower acidity, which may necessitate further treatment in an anaerobic wetland (see next section) or via direct chemical applications. Finally, the metal precipitate sludge may fill and clog the aerobic wetland over time to the extent that the system needs maintenance, reconstruction, or replacement. Removal and disposal of accumulated sludges can be expensive, especially if the sludges contain high concentrations of toxins.

Overview of Anaerobic Wetlands

Anaerobic (nonoxygenated) wetlands, also referred to as compost wetlands, are very similar to aerobic wetlands. The major difference between the two is the thick, oxygen-free organic substrate through which the CMD flows upon entering the system. This substrate consists of a layer of matted decaying material on the bottom of the wetland, where bacteria-driven processes occur that break down the sulfates (SO4) that form part of CMD's sulfuric acid (H2SO4) and gypsum (CaSO4) content. Iron-reducing anaerobic bacteria, which can survive at low pH values, are also active in this oxygen-free zone. Anaerobic wetlands represent an inexpensive method suitable for treating some CMD discharges.

The primary agent in the acid-reducing process is bacterial action that break down sulfates by using oxygen atoms bound to the sulfate (SO4) molecules. The oxygen is consumed by metabolic processes of the living bacteria. (This process is also used in the alkalinity-producing systems reviewed in the following section.) The bacteria thrive in the oxygen-free, rich, organic mass of the substrate. They have been found to raise pH readings from 1.1 to more than 6.0 without additional chemical treatment.

As sulfates are reduced by anaerobic bacterial activity, metals in the CMD begin to precipitate as sulfide compounds. Copper, if present, precipitates first, followed by lead, zinc, cadmium and eventually, iron. Aluminum does not form a metal sulfide, and the high solubility of manganese makes formation of a precipitate unlikely. The removal of these metals is accomplished through precipitation processes as the pH is increased.

Flow rates of the discharge determine the size requirements of the wetland area, and both flow and CMD chemistry determine the required holding time. If the pH of the inflowing CMD is less than 3 and adequate residence time cannot be designed into the system, additional alkalinity will be needed. Limestone is sometimes used in the anoxic zone beneath the organic substrate to increase the amount of alkalinity (see next section). The flow is directed first through the limestone and then through the organic substrate. When limestone is used, the dissolved oxygen level must be less than 2 mg/L to prevent armoring of the crushed limestone. (See previous section for details on armoring.) Substrate materials containing alkaline material, like spent mushroom compost, can also be used to raise pH. Careful regulation of the flow and dispersal through the wetland is necessary to ensure adequate holding time for treatment to occur.

Limitations of Anaerobic Wetlands

As with aerobic wetlands, space considerations and the long-term capabilities of the system represent primary limitations in utilizing anaerobic wetlands. Temperature is also a limiting factor in the performance of an aerobic wetland. During the winter, the rate at which acidity and metals are removed can decrease because the bacteria are less active in cold weather. Replacement or recharging of the organic substrate might also be necessary as various microbial species break down and consume the material. Finally, metal precipitates settling out of the wetlands can fill and clog the bottom of the cells with sludge to the extent that the system needs maintenance, reconstruction, or replacement.

Overview of Alkalinity-Producing Systems (APS)

APS combine the chemical processes of limestone ponds with the biological processes of anaerobic wetlands to treat CMD with high acidity and elevated metal concentrations. APS are ponds with perforated pipe underdrain systems overlain with crushed limestone and a layer of organic material. These ponds, which produce alkalinity through successive processes, are often called successive alkalinity-producing systems, or SAPS.

The CMD flows into the SAPS pond where it is initially exposed to conditions favoring the oxidation and precipitation of metals, and the settling of these and other suspended solids. The CMD then percolates through the anoxic zone containing organic matter and crushed limestone. Iron is filtered through adsorption by the organic material or reduced to ferrous iron and deposited in the substrate by the action of resident bacteria. Bacterial action in the organic layer also breaks down sulfates, decreasing acidity. The layer of crushed limestone in the anoxic zone of the wetland further decreases acidity, without the threat of armoring. The treated CMD then flows into the perforated pipe to an outlet, where it can be aerated, held in a sedimentation pond or filtered through a wetland for the removal of any remaining metals or suspended solids.

When this system design is sited over a CMD seep, it is referred to as a reverse APS. A reverse APS is a man-made pond with a bottom layer of organic material overlain by limestone, built over a CMD seep. As the CMD seeps up through the bottom of the pond, metals are filtered and adsorbed by the organic material. Bacteria in the matted organic layer reduce metals through metabolic processes, and decrease dissolved oxygen while decomposing the organic material. Alkalinity is added to the CMD as it rises through the limestone in the anoxic zone. The treated CMD exits the system through an open channel spillway, where aeration occurs. Remaining metals in the CMD oxidize in the aerated water, precipitate and settle from the solution in a sedimentation pond.

Limitations of Alkalinity-Producing Systems

Space is a possible limitation, though space requirements are not as extensive as those encountered for wetland systems. The specific content of the various contaminants in the CMD will dictate how much area is needed for the system to achieve the desired level of treatment. Topography must also be suitable to allow for flows through the treatment system. The flow rate within the system is governed by the porosity of the organic material and limestone, and it can be restricted due to clogging caused by sediment accumulation on top of the limestone and organic layers. When clogging occurs, the organic material and limestone might need to be replaced.

ACTIVE TREATMENT SYSTEMS

Active and passive CMD remediation systems usually integrate components that employ chemical, biological, and physical processes. The chemical (i.e., active) component of a CMD clean-up system involves a process in which CMD is brought into contact with an alkaline substance through direct mixing/application, or by channeling or pumping the CMD to a location where alkaline material (e.g., hydrated lime) is present. This process is designed to neutralize the acid in the CMD through the buffering action of the alkaline substance. Raising the pH of CMD is often essential for further treatment, since highly acidic discharges prevent the oxidation and settling of metals in the settling pond and/or wetland component of a treatment system. High acidity can also kill the plants, aquatic organisms, and sulfate reducing bacteria found in biological systems.

Small CMD flows are often treated by mixing powdered lime or other high-pH material with the drainage water. For larger flows, a common approach is to construct a collection device for the CMD (pond or diversion ditch), channel the flow to the treatment area (a covered or open ditch containing an alkaline substance or a treatment plant designed for the specific remediation option), and then route the discharge from the treatment area to one or more settling ponds, where suspended solids and metals settle out. In some cases, additional chemicals are added to the sedimentation ponds to speed the settling process.

Six chemicals are typically used to treat CMD: limestone (calcium carbonate ($CaCO3$)), hydrated lime (calcium hydroxide ($CaOH$)), quick lime (calcium oxide, (CaO)), soda ash briquettes (sodium carbonate, ($NaCO3$)), caustic soda (sodium hydroxide, ($NaOH$)), and anhydrous ammonia ($NH3$)). The purpose of the alkaline chemicals is to neutralize the acidity of the CMD, which also allows dissolved metals like iron (Fe), manganese (Mg) and aluminum (Al) to solidify and settle out as a metal hydroxide sludge. Dissolved metals in the treated CMD can also be removed by an application of potassium permanganate (KmnO4), other oxidizing agents, and even aeration in the settling pond, which are all effective in precipitating iron and manganese. In situations where manganese concentrations are particularly high, caution should be exercised in using permanganate because of the possibility of adding to the concentration of manganese. In cases such as this, briquettes composed of both soda ash and potassium permanganate can be used.

Metals like iron and manganese require aeration or bacteria-induced reduction so the metal solids (precipitates) become stable compounds and settle out of the CMD. Aeration accelerates the solidification of the metals dissolved in the CMD solution after the pH is raised. In most cases, aeration is accomplished by exposing CMD to the air via the large surface areas of ponds and wetlands. The designed residence (or holding) time in settling ponds is dependent on the pH of the CMD, the concentration of dissolved metals, the ability of the pond to handle rain infiltration and resist runoff impacts, pond maintenance practices, and the amount of dissolved oxygen in the acidic solution. Mechanical aerators such as waterfalls, stair-step flumes, or other structures which cause the water to "tumble" will result in aeration. Other aeration options involve spraying CMD water into the air, or allowing the water to cascade down a sluiceway before it enters the settling pond. This can be done either before or after the neutralizing chemicals have been added to the CMD. Larger systems sometimes feature diffused air injector systems, submerged turbine generators, or surface aerators like those used at sewage treatment plants.

Active System Chemicals: Limestone

Limestone (calcium carbonate, CaCO3) is the cheapest, most stable, safest, and easiest chemical substance to use. Crushed limestone is less caustic than lime, and cannot be overdosed in a CMD treatment system, so the feed rate of limestone to CMD requires minimal calibration. Limestone also creates a dense, heavy sludge that settles fast. Availability is usually no problem, and purchase, delivery, and handling costs are low. It can be stored indefinitely.

Limestone treatment of CMD can be accomplished in the presence of atmospheric oxygen (oxic) or in its absence (anoxic). If the concentration of iron and other metals is low, oxic treatment in open trenches (also called "drains") filled with crushed limestone is the preferred approach. Oxic trenches have been used in Pennsylvania, and the estimated life of the limestone material before refilling is necessary was found to be about 5 to 10 years. However, most CMD contains moderate or elevated concentrations of dissolved metals, and allowing the limestone treatment process to occur in the presence of oxygen causes a buildup of metallic hydroxide compounds on the surface of the limestone (armoring). This coating prevents the CMD from coming into contact with the limestone, which halts the treatment process.

To prevent armoring while treating CMD with high metal concentrations, anoxic limestone drains (ALDs) or pipes are used. The purpose of anoxic drains is to eliminate the presence of atmospheric oxygen by enclosing the limestone-containing trench or pipe to prevent contact with the air. If a trench is being used, it is covered with an impermeable cap, which allows a slow release of the carbonate material from the limestone without the decrease in effectiveness caused by armoring. The life of the limestone varies in accordance with the chemical content of the CMD, the flow, and the amount of limestone present.

Anoxic limestone drains are cheap and effective when the amount of dissolved oxygen in the trench and CMD is kept low (less than 2 milligrams per liter, or mg/L). The reactivity of limestone is dependent on the percent of calcium (Ca) in the CaCO3 and the size of the particles. A variation of sizes might be best. Small particles offer more surface area per volume of crushed limestone, which increases reactivity, but large particles dissolve slower, allow better flow and last longer. A mixture of particle sizes may also facilitate water movement due to greater porosity in the limestone bed.

Both oxic and anoxic approaches are often components of larger, integrated treatment systems, as noted above. The usual sequence is to provide for collection of the CMD in a pond or ditch, allow sediments and precipitated metals to settle out, route it through the limestone drains, then pass it through wetlands (see following section) for final treatment. Sometimes a settling pond is included prior to discharge to remove any remaining suspended solids.

Another approach to using limestone involves a device called a diversion well. In this approach, CMD is routed to a pipe that empties into a cylinder filled with limestone gravel. A drop of 8 feet or more is designed into the system, so that the falling water hits the limestone in the cylinder with enough force to continuously clean armoring products from the limestone. Limestone gravel in the well must be replaced every week or two. After leaving the diversion well, the CMD is usually routed to oxidizing wetlands, which remove metal hydroxides, and reducing wetlands, which reduce metals, to allow for removal of the metal hydroxides washed from the limestone and to ensure proper pH levels at final discharge. Here again, a settling pond may be used for final sedimentation.

Some small CMD seeps are treated by constructing a limestone pond at the site. Limestone ponds have a bottom layer of crushed limestone, and they are built over the CMD seep. As the anoxic (oxygen-free) CMD seeps through the limestone, alkalinity from the limestone is added and the pH increases. After the CMD is discharged from the limestone pond, it is aerated and metals and other particles are settled out in a sedimentation pond or filtered through a wetland. Limestone ponds are often used at the source of an anoxic CMD discharge unless the metal content is low and an oxic trench would suffice. Stirring might be needed occasionally to uncover the limestone at the bottom of the pond if armoring and clogging occur, especially if the sediments block off the seep that is being treated.

Limitations of Limestone

Designing, constructing, and maintaining limestone treatment systems is expensive and involves an ongoing commitment of years, even decades. Limestone is not effective when the buffering potential (total alkalinity) of the water reaches 7.5 or greater. Limestone has a low solubility in water, which causes the reaction rate to be slow. The rate will decrease further if oxygen is present and iron concentrations are above 5 mg/L as a result of the limestone becoming armored. Preventing armoring in anoxic trenches or pipes can be quite involved, and if armoring occurs, removing the cap and replacing or washing the limestone material represents a considerable task.

When concentrations of sulfate (SO4) are above 2,000 mg/L, a reaction occurs between the limestone and sulfate that produces a solid gypsum (calcium sulfate, CaSO4) precipitate. This precipitate, deposited in the form of a sludge, is insoluble and can cause clogging between the limestone rock or in the pipes. Another possible drawback of limestone treatment is calcium hardness in the effluent, which is contributed by the Ca (calcium) atoms in the CaCO3 (limestone). The approach is expensive, but not as costly as some other options.

Active System Chemicals: Hydrated Lime

Hydrated lime (Ca(OH)2) is another reagent commonly used to treat CMD. During the treatment process, the hydrated lime is usually mixed into a slurry/suspension using the raw mine water. It can be applied in either dry or liquid form, is safe to handle, and is fairly inexpensive. Hydrated lime is cost-effective when the CMD has a large flow and high acidity, and requires treatment for an extended period of time (more than 3 years). It has been proven effective for extreme conditions, such as a flow rate of 1,000 gallons per minute (gpm) and acidity of 2,500 mg/L. The product is often mixed with CMD in a treatment plant or small mixing device regulated by drainage flow. When ferrous iron (Fe2+) concentrations are high, hydrated lime is often used with an aerator to add oxygen (O2) to the water. The ferrous iron oxidizes to form ferric iron (Fe3+), which precipitates out into a solid at a lower pH. This process reduces the amount of hydrated lime needed to remove the iron from the CMD.

Limitations of Hydrated Lime

Extensive mixing is required for the hydrated lime to become soluble in water. When sulfate concentrations in the CMD are greater than 2,500 mg/L, an insoluble gypsum precipitate can be produced as a sludge, which can cause flow or deposit problems that could clog the system. Finally, the sludge produced in a hydrated lime system is not very dense and does not settle out completely. This fluffiness makes it difficult to handle during sludge cleaning.

Active System Chemicals: Quick Lime

Quick lime (CaO) is very reactive and economical. It can be used for small and/or periodic flows having high acidity. Metering equipment is needed, so quick lime may not be appropriate in remote areas. The product is less expensive than sodium-based neutralizing chemicals. About half the weight of quick lime is needed to neutralize a given quantity of acid compared to crushed limestone or soda ash.

Limitations of Quick Lime

Quick lime is seldom used in industry for permanent treatment systems because of the formation of gypsum (CaSO4), which precipitates out of the CMD through a chemical reaction between the calcium (Ca) and sulfate (SO4) in the CMD. The formation of this sludge-like precipitate can result in clogging of conduits in the treatment system. In addition, handling of quick lime can be a problem because of the heat generated as it reacts with water. Serious burning of the eyes can also be problem in using this dusty, flour-like product.

Active System Chemicals: Soda Ash

Soda ash (NaCO3), in either a briquette or slurry form, is commonly used to treat CMD characterized by low flow rates and low acidity. The briquettes are easier to handle than some calcium-based neutralizing chemicals. Treatment systems are designed so the CMD flows over the briquettes in a box or other structure. Soda ash briquettes can be used in remote areas, again mostly for short-term applications to CMD discharges marked by low flow and low concentrations of acidity and metals.

Limitations of Soda Ash

When the concentration of iron is greater than 10 or 20 mg/L, a mixing system is needed to increase efficiency. Soda ash briquettes have a lower solubility and a higher cost when compared to other sodium-based neutralizing chemicals (i.e., caustic soda).

Active System Chemicals: Caustic Soda

Caustic soda raises the pH of the CMD rapidly due to its high solubility and quick dispersion. It is often used in temporary treatment of low flows with high acidity, or in treatment of high manganese concentrations. A common use of caustic soda is to boost pH values well beyond neutral (pH = 7) and on up to the fairly alkaline 10.0 range. This approach is used to achieve quick precipitation of dissolved manganese in the CMD. Manganese precipitation is fairly slow at pH readings of less than 8.0. Raising the pH to 8.0 and higher allows some buffering downstream if other small CMD flows combine with the treatment system discharge.

Limitations of Caustic Soda

Caustic soda produces a ferric hydroxide (FeOH3) sludge that has a gel-like consistency. It is a little more expensive than some other chemical approaches, and caution must be used when handling the chemical to prevent excessive application. Caustic soda can rapidly raise the pH level to extremely high alkaline values. In cold conditions, caustic soda can freeze and be difficult to handle.

Active System Chemicals: Anhydrous Ammonia

Anhydrous ammonia (NH3) is commonly used in West Virginia and other states to treat small discharges through direct application. Application rates are computed by considering the volume, flow, and pH of the discharge to be treated. This product, which acts as a weak base, can cause serious burns if it gets into the eyes. Care must be taken when handling ammonia products.

Drawbacks to Active Chemical Treatment

Actively applied chemical treatment is only a temporary solution to the problem, since it does not eliminate the source of the CMD or prevent its formation. Applied or mixed chemical treatment requires constant maintenance and is relatively expensive. Passive treatment with limestone trenches or ponds is also a temporary solution; however, is more cost effective and requires less maintenance (see following sections). The metals and other precipitation products that settle from the CMD in the holding ponds or wetlands can contain high levels of toxic compounds. In this case, the sludge must be disposed of in a manner that ensures it will not contribute to water pollution after it is removed. Sometimes the sludge can be buried in specially designed containment areas near the treatment site, as long as care is taken to minimize the infiltration of rain water and exposure of the sludge to the weather. Sludge disposal can add considerable cost and ongoing maintenance requirements to a CMD remediation project.

RECLAMATION AND REMEDIATION

Prevention, of course, is the preferred method for dealing with CMD. Preventing the formation of contaminated drainage involves reducing or eliminating contact between acidic or metallic wastes and precipitation or stream flows. This can be accomplished by capping waste piles to prevent rain infiltration or by re-routing streams to avoid contact with CMD sources. Neutralizing wastes through the mixing of acidic wastes and those with alkaline properties also helps prevent CMD formation. Finally, analyses of CMD discharge sites sometimes finds that sites can be filled, sealed, or remined to prevent CMD from forming. These situations are highly site-specific and require the services of engineering and geological professionals.

Filling and Sealing

If field investigation determines rainwater is flowing into underground mineworks through identifiable openings at the surface, it might be possible to fill and/or seal the openings to prevent infiltration and eventual formation of CMD. Tracer dye tests can indicate whether infiltration points such as cracks, holes, or mine shaft openings are creating a CMD discharge at another location. In general, the best approach is to seal off any openings that lead into underground mineworks to prevent rain infiltration. Likewise, any channelized flows of storm water that disappear into mine area cracks or shafts should be diverted so they do not flow through iron sulfide material and generate CMD.

Remining

In some cases, there is still recoverable coal in the vicinity of CMD discharges. As your group investigates and maps CMD sites, it is important to note the names and addresses of property owners in site investigation records. Before CMD sites are scheduled for expensive treatment system construction, it might be worthwhile to have a geologist determine whether enough coal is present at the site to justify remining. Some old mines were worked before the development of modern equipment, so it is possible that significant coal reserves are still present. The remining contractors would be charged with ensuring that the remining operations prevent the generation of CMD by incorporating careful planning, engineering, and operational approaches into the remining work. The isolation or neutralization of CMD-producing earthen wastes is accomplished by mixing acidic and alkaline wastes in a manner that prevents CMD formation, or by isolating problem wastes beneath impermeable caps.

The Clean Water Act allows less stringent limits for remining activities, but water quality standards must not be violated. This has created an obstacle for some remining operations, and officials from EPA and OSM are exploring regulatory approaches to promote remining as a no-cost CMD clean-up option while minimizing water quality impacts. As with all mine permitting processes, it is important for concerned citizens to monitor remining permit proceedings to ensure that all necessary consideration is given to site-specific conditions, water resource protection, adequate bonding and insurance, and reclamation provisions.

Potential Funding Sources for Mine Drainage Abatement

Organization	Contact	Phone No.	Comments
FEDERAL GOVERNMENT			
U.S. Army Corps of Engineers			
Baltimore District	James Johnson	(410) 962-4900	Section 1135: applies to watershed projects damaging Corps property or if Corps projects are having a negative effect that would result in AMD formation. The project area has to be on public lands.
Philadelphia District	Robert Callegari	(215) 656-6540	
Buffalo District	Phillip Berkeley	(716) 879-4145	
Detroit District	David Dulong	(313) 226-6766	
Huntington District	Jim Everman	(304) 529-5636	Section 206: Aquatic Ecosystem Restoration Program. This program has not yet been funded.
Louisville District	Jeff Klekner	(502) 582-5658	
Nashville District	Tom Waters	(615) 736-5646	Planning assistance to states for watershed cleanups.
Pittsburgh District	Jack Goga	(412) 644-6817	
Mobile District	Roger Simmons	(205) 690-2777	Stream Bank Erosion Program.
U.S. Department of Agriculture Natural Resources Conservation Service			
Lexington, KY	David G. Sawyer	(606) 224-7350	*PL 566:* Small watershed program *PL534:* Flood prevention program. *Resource Conservation and Development Program:* provides technical assistance to help identify problems and locate funding. *Wildlife Habitat Incentives Program:* Under the Farm Bill.
Columbus, OH	Patrick K. Wolf	(614) 469-6962	
Harrisburg, PA	Janet L. Oertly	(717) 782-2202	
Morgantown, WV	William Hartman	(304) 291-4153	

Organization	Contact	Phone No.	Comments
U.S. Department of Energy (DOE) Morgantown Energy Center Morgantown, WV	Robert Bedick	(304) 285-4505	Availability of funds will depend on Congressional budget authorizations and proposed organizational changes.
FE-232 Office of Coal Combustion Control Systems	Douglas Uthus	(301) 903-0479	Projects of this kind are funded by the appropriate DOE Field Center.
Advanced Research and Environmental Technology	Neil H. Coats Jer Yu Shang	(301) 903-6229 (301) 903-2795	Advanced Research and Environmental Technology (Env) $2.5 Million FY96.
Coal Preparation	Randy Penington	(301) 903-3485	R&D project funding.
Environmental Science & Technology Div.	Bob Kleinman	(412) 892-6555	Provides technical assistance.
U.S. Environmental Protection Agency U.S. EPA Region III			
Environmental Justice (EJ)	Reginald Harris	(215) 566-2988	Provide financial assistance to eligible community groups. Organizations must be incorporated to receive funds.
Section 319	Hank Zygmunt	(215) 566-5750	Provides financial support for projects which demonstrate water quality improvement from non-point source pollution.
Source Watershed Protection Program			Provides financial support for projects which potentially impact drinking water supplies
Environmental Justice through Pollution Prevention (EJP2)	Jeff Burke	(215) 566-2761	To use pollution prevention resources for addressing environmental problems in low income, high minority areas.
Sustainable Development Challenge (SDC)	Mindy Lemoine/ Theresa Martella	(215) 566-2736	Provide community funding for establishing partnerships to encourage environmentally and economically sustainable business practices.
Environmental Education (EE)	Nan L. Ides	(215) 566-5546	Provide financial support for projects which design, demonstrate, disseminate environmental education practices, methods, or techniques.
Appalachian Regional Commission	Karen Holloway	(202) 884-7754	

Organization	Contact	Phone No.	Comments
U.S. Department of Interior Office of Surface Mining			
Clean Streams Initiative	James Taitt	(412) 937-2106	Provides funding for stream cleanups impacted by AMD from abandoned coal mines.
Abandoned Mine Land Program (AML)			Established by Title IV of SMCRA. Under this program, fees collected from coal operators go to the Abandoned Mine Reclamation Fund (AMRF). Most AMRF monies are potentially available for contaminated CMD cleanup.
Pittsburgh, PA	James Taitt	(412) 937-2106	AMD Program Coordinator.
Harrisburg, PA	Dave Hamilton	(717) 782-2285	PA ACSI Coordinator.
Maryland	Pete Hartman	(301) 724-4860	MD ACSI Coordinator.
Charleston, WV	Rick Buckley	(304) 347-7162	WV ACSI Coordinator.
Columbus, OH	Max Luehrs	(614) 866-0578	OH ACSI Coordinator.
Big Stone Gap, VA	Ronnie Vicars	(540) 523-0024	VA ACSI Coordinator.
Lexington, KY	Dave Beam	(606) 233-2896	KY ACSI Coordinator.
Knoxville, TN	Willis Gainer	(423) 545-4103	TN ACSI Coordinator.
STATE PROGRAMS			
Abandoned Mine Lands Program	Your state office		
Special Reclamation Fund	Your state office		
Acid Mine Drainage Abatement and Treatment Fund - 10% Set Aside.	Your state office		
State Revolving Fund	Your state office		
State Nonpoint Source Programs	Your state office		
State Division of Natural Resources	Your state office		
Civil Penalties	Your state office		
State's Development Office	Your state office		
Federal and State Appropriations	Your state office		
Governor's Discretionary Funds	Your state office		

Organization	Contact	Phone No.	Comments
State of Maryland			
State of Maryland	Suzanne Arcella *State Coordinator*	(401) 631-3584	RFPs for Maryland 319 Funds come out in April each year. The Maryland Mining Program can compete for funds.
Maryland Department of Environment *Water Management Administration*	J.L. Hearn *Director*	(410) 631-3567	MDE has an established tradition of supporting projects with funding in which they have an interest.
Maryland Bureau of Mines (BOM)	Connie Lyons John Carey	(301) 689-6764 (301) 689-6764	Source of additional contacts.
Maryland Geological Survey	James Reger Ken Schwartz Emery Cleaves	(410) 554-5523 (301) 689-6104 *(410) 554-5504*	Potential source of contribution; source of additional contacts.
State of Pennsylvania			
Mineral Resources Management Bureau of Abandoned Mine Reclamation	Ernie Giovennetti *Director*	(717) 783-2267	Source of potential funding; additional contacts; information.
State of Virginia			
Department of Mines, Minerals, & Energy Division of Mined Land Reclamation	Bob Herron *Coordinator*	(540) 523-8100	Source of potential funding; additional contacts; information.
State of West Virginia			
Stream Mitigation Fund	Ken Politan	(304) 759-0510	
Section 319	Lyle Bennett		
RESEARCH ORGANIZATIONS / ENDOWMENTS / TRUSTS			
Heinz Endowments	Andy McElwaine	(412) 281-5777	The Heinz Endowments holds two meetings per year (Spring and Fall) to allocate funds from two separate Heinz endowments. The Howard Heinz Endowment is solely for projects inside the State of Pennsylvania. The Vira Heinz Endowment occasionally considers projects outside of Pennsylvania and does fund AMD projects.

Organization	Contact	Phone No.	Comments
ENVIRONMENTAL ORGANIZATIONS			
Clean Water Action	David Zwick	(202) 895-0420	In-kind technical/scientific consultation; In-kind research support; networking.
American Rivers	Rebecca Wadders	(202) 547-6900	In-kind research support; media support; networking.
Friends of the Earth		(202) 783-7400	In-kind research support; media support; networking.
Friends of the River	Betsy Reifsnider	(415) 771-0400	Funds river preservation and restoration projects through Friends of the River Foundation; media support; networking.
Izaak Walton League of America		(703) 548-0150	In-kind research support; media support; networking.
National Water Resources Association	Tom F. Donnelly	(703) 524-1544	Bestows awards; networking.
River Network		(202) 364-2550	In-kind research support; media support; networking.
Sierra Club	Carl Pope	(415) 977-5500	Bestows awards; networking; media support.
Society for Ecological Restoration	William Jordan	(608) 262-9547	In-kind technical/scientific consultation; networking.
Thorne Ecological Institute	Steve Eandi	(303) 499-3647	In-kind technical/scientific consultation; networking.

Appendix G: Fact Sheet on OSM's ACSI Funding

Note: For additional questions on this fact sheet, contact Jim Taitt, AMD Program Coordinator, at (412) 937-2106.

Fact Sheet

Frequently Asked Questions About OSM's Appalachian Clean Streams Initiative (ACSI) Funding

Background: The Surface Mining Control and Reclamation Act of 1977 (SMCRA) created the Abandoned Mine Reclamation Fund, a fund consisting of tonnage-based fees collected from coal producers. This Fund is used to mitigate the effects of past mining practices and protect people, property, and the environment from problems left after coal companies mined lands and left them unreclaimed prior to SMCRA. These problems include subsidence, landslides, mine fires, mine drainage, open shafts, highwalls and other hazards and environmentally degrading effects. Each year Congress appropriates monies from the Fund for abandoned mine land (AML) reclamation as outlined below.

The law requires that one half of the funds collected within a State or Indian tribal boundaries be reserved for use by that State or Indian tribe. These "state share" funds are made available to the States and Indian tribes through grants authorized by the Secretary of the Interior, acting through the Office of Surface Mining Reclamation and Enforcement (OSM). To receive a grant, a State or Indian tribe must have a reclamation plan approved by the Secretary. The other half of the funds collected is divided into "shares" for a variety of uses. For example, funds are used to handle emergency reclamation needs (an AML problem that must be addressed more quickly than could happen under the grants process), for reclamation in States that do not have approved reclamation plans, for expenses associated with operating the AML program, for additional grants to the States and Tribes for their reclamation efforts, and for other purposes authorized by Title IV of SMCRA.

SMCRA establishes a priority system which generally results in reclamation of the most serious eligible AML problems first. The top three priorities in this system are as follows:

- The protection of public health, safety, general welfare, and property from extreme danger of adverse effects of coal mining practices;

- The protection of public health, safety and general welfare from adverse effects of coal mining practices; and

- The restoration of land and water resources and the environment previously degraded by adverse effects of coal mining practices.

Historically, AML-related water quality problems were generally deemed to be a Priority 3 problem, making it difficult for State and Tribes to fund a significant number of water restoration problems, The 1990 Amendments to SMCRA made specific mention of adverse economic impact upon a local community as a reason for giving priority to the reclamation of certain sites. OSM recognized the importance of acid mine drainage (AMD) problems and the potential impacts AMD has on local communities. Beginning in 1995, OSM encouraged States and Tribes to consider whether their AMD pollution sites could be considered "general welfare" problems that had an adverse economic impact upon a community. Such an interpretation gives these water problems a higher priority and allows them to compete more easily for limited AML dollars. The process has facilitated the funding of Appalachian Clean Streams Initiative projects. For fiscal year (FY) 1997, Congress authorized Clean Streams funding as a supplement to Title IV State grants, i.e., funds earmarked especially for stream clean up.

SMCRA also provides that up to 10 percent of the annual grants to States and Tribes may be set aside in State-managed accounts for use in cleaning up mine drainage problems. Monies deposited in an acid mine drainage set-aside fund may draw interest. The AMD set-aside fund also emphasizes a watershed-based approach to land reclamation and stream clean up. OSM has determined that funds in these accounts be State/Tribal funds and, therefore, can be used to match other Federal grants (e.g., Environmental Protection Agency, Clean Water Act Sec. 319 or Corps of Engineers, Water Resources Development Act Sec. 1165 grants) for stream cleanup activities.

In the FY 1997 appropriation, Congress authorized States and Tribes to use <u>any</u> of their AML grant funds to match other Federal dollars as long as the purpose is environmental restoration-related to treatment or abatement of acid mine drainage from eligible abandoned mines and if the project is consistent with SMCRA's purposes and priorities. This provides even greater flexibility to leverage Federal dollars to cooperate in stream restoration activities. [note: this measure is renewable annually as part of the AML appropriation].

Following are some frequently asked questions concerning the Clean Streams Initiative and project funding.

Question 1: What is the Clean Streams Initiative? What types of projects qualify for funding?

Answer 1: The Clean Streams Initiative (Clean Streams) is a government-public alliance whose goal is to clean up streams and rivers polluted by acid and toxic drainage from abandoned coal mines. This initiative encourages increased information exchange, multi-agency coordination, and the formation of partnerships among government, citizens, and corporations to bring innovative solutions to this national problem.

Basically, any abandoned mine land coal problem area eligible under Title IV of SMCRA, with water pollution related to mine drainage acidity, metals, or toxicity, may be a potential Clean Streams project. Because acid mine drainage problems are often very expensive to clean up and funds are extremely scarce, OSM and the States/Indian tribes are able to provide only limited funding for Clean Streams projects.

Question 2: How does a State/Indian tribe request Clean Streams funds?

Answer 2: After the annual Appropriations Act is signed by the President, OSM makes funding decisions for its various programs based on appropriation mandates and available funding. OSM Headquarters then prepares authorizations to the Regional Coordinating Centers/Field Offices to expend funds and award grants. Assuming that the Federal budget is passed by the beginning of the fiscal year on October 1, the AML grant funds (including Clean Streams funds) are usually available for distribution sometime after December 1 of each year.

For FY 1998, OSM and the States/Indian tribes are developing the process and guidelines that will be used for Clean Streams project submissions. Projects will be submitted to the applicable State/Indian tribe AML agency for funding consideration. After the Appropriation Act is signed, the States/Indian tribes will be notified about the amount of funds earmarked for their clean streams initiative projects. To request grant funds, a State/Indian tribe prepares an AML grant application. Procedures for applying for a grant are outlined in regulations (e.g., 30 CFR 886; 43 CFR 12) and OSM's Federal Assistance Manual. A State/Indian tribe may include its Clean Streams project funding request as a part of its total AML grant request or as a supplemental request to an existing grant. In either case, OSM approves a grant request after all requirements are met, and then a State/Indian tribe may draw AML funds on its established letter-of-credit to meet its program/project needs.

Question 3: Are there differences between the Clean Streams grant requirements and the standard requirements for Abandoned Mine Land projects?

Answer 3: Clean Streams grants may only be used for the reclamation of eligible abandoned sites with acid mine drainage problems from coal mines. Other than that, the Clean Streams grants are a subset of the overall AML grants program; thus, the same requirements apply. The proposed stream clean up project must be eligible to receive Title IV funds. The proposed site must be listed in the national Abandoned Mine Land Inventory System. The State/Indian tribe must follow the procedures found in the Federal Assistance Manual for receiving/administering AML funds and in its approved reclamation plan. This includes the requirements of the National Environmental Policy Act and other applicable Federal and State laws. Upon receiving and finding acceptable the required material from the State/Indian tribe, OSM issues an authorization to proceed.

Question 4: What is the acid mine drainage set aside? When can a State/Indian tribe set aside its AML funds?

Answer 4: The acid mine drainage 10 percent set aside was originally created to give States/Indian tribes more flexibility to address AMD problems. Funds to be set aside are awarded either as part of a State's/Indian tribes new AML grant or as a supplement to an existing grant. [Note: set-aside funds are considered State/Indian tribe money and, thus, earn interest and can be used as matching funds for other Federal dollars.]

Question 5: Can a State/Indian tribe set aside 10 percent of Clean Streams Initiative funding for future reclamation?

While there is no specific written prohibition, OSM encourages States/Indian tribes to use their entire Clean Streams Initiative supplemental funding for direct, construction-related purposes. By doing this, on-the-ground successes can be attained more quickly, which could help generate future funding support from multiple sources.

Question 6: If the State/Indian tribe receives Clean Streams Initiative grant funds, must it be spent within the year the funding was appropriated?

Answer 6: Clean Streams monies do <u>not</u> have to be spent within the fiscal year they are appropriated. However, OSM assumes that projects selected by States/Indian tribes are sufficiently far along in the planning process for construction to proceed quickly.

Question 7: Are there restrictions on utilizing Clean Streams Initiative grant money for overhead costs (e.g., planning, design, long-term monitoring equipment, drilling, office equipment, salaries, mileage, etc.)?

Answer 7: The annual grant comprises several direct and indirect cost components. OSM is encouraging all States/Indian tribes to use the entire Clean Streams supplemental grant for direct, construction-related purposes only, rather than on necessary administrative expenses. In FY 1997, OSM is working with the National Mined Land Reclamation Center (NMLRC) to provide some technical support during the pre-construction, construction, and post-construction phases of the Clean Streams Initiative projects identified for funding. If the States utilize the expertise of the NMLRC to the extent available, design and engineering-related expenses would be reduced and thus the funds devoted to direct construction work would be maximized.

Question 8: Can Clean Streams Initiatve funds be used for maintenance?

Answer 8: Clean Streams funds generally are to be used for construction. Funds could be used for maintenance if a State/Indian tribe applies for and received Clean Streams funding for this purpose. Proposed maintenance projects would be ranked and selected according to the same selection criteria applicable to all Clean Streams Initiative projects.

Question 9: Can States/Indian tribes give Clean Streams Initiative funds to a private entity to set up a trust to cover maintenance?

Answer 9: The law does not allow AML funds to be set aside for future use except for approved State/Tribal set-aside programs. A State/Indian tribe could fund maintenance out of its approved set-aside fund or as an annual portion of new grant funds.

Question 10: Can States/Indian tribes utilize Clean Streams Initiative funding that was previously justified for one Clean Streams project on a different Clean Streams project site?

Answer 10: Yes, under certain circumstances and subject to the Clean Streams Initiative special grant condition and the State's/Indian tribe internal procedures. For example, if a State obtains funding for Clean Streams Project #1 from another source prior to OSM's appropriation then it would be appropriate for Project #2 to receive an Clean Streams dollars that remain after meeting Proejct #1's needs.

Question 11: If a Clean Streams Initiative project is funded in one fiscal year, but does not receive enough funding to be completed, will additional Clean Streams fund automatically follow in successive fiscal years?

Answer 11: The purpose of the supplemental Clean Streams Initiative funds is not to fund projects at 100 percent of anticipated reclamation costs. The Clean Streams funds are "challenge grants," providing seed money that can be used to attract additional financial support from other public and private sources. Partially funded projects will have to compete on their merits with other potential clean streams projects in a State/Indian tribe for any funds appropriated by Congress.

Question 12: How can funding be obtained for cleaning up a mine drainage problem in my community?

Answer 12: State Abandoned Mine Land reclamation programs identify, set priorities, and make funding decisions for all AML reclamation operations, including Clean Stream projects. In a few states, e.g., Tennessee, OSM directly administers a Federal Reclamation Program and has some limited funds for AML reclamation. The best way to get a stream considered for funding is to demonstrate to the State reclamation authority that you have a grassroots organization serious about cleaning up the problem. For example, watershed groups can demonstrate this commitment by showing that they have broad community support and have identified other potential funding partners (Federal or State agencies, foundations, local governments, private contributions, etc.) Contact your State AML agency for a complete list of its criteria and stream nomination procedures.

Question 13: I belong to watershed organizations and other private groups advocating clean streams projects. Will my organization ever be able to receive Clean Streams funding directly from OSM?

Answer 13: OSM is authorized to provide funding in the form of grants and cooperative agreements to eligible **States and Indian tribes only.** Each State operates its AML program under State laws, regulations, and policies governing expenditure of funds. So, the distribution of Clean Streams monies to a construction contractor or consultant, the U.S. Department of Agriculture's Natural Resources Conservation Service, a State agency, local government, an individual, a college, or any other bona fide entity that will perform some aspect of Clean Streams work is set by the State process. To determine whether your organization can receive money from the State, contact your State AML program agency.

Question 14: What must be done to assure the long-term viability of funding for Clean Streams projects?

Answer 14: OSM depends on the Congressional appropriation to provide its portion of Clean Streams funding. However, this was never intended to be more than seed money to generate additional interest and attract other sources of funding. OSM anticipates that AMD reclamation successes in 1997 will help generate future support from multiple sources. The best way to guarantee long-term viability is to establish diverse sources of funding.

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References

A publication of the Pennsylvania Association of Conservation Districts. *Pennsylvania Resources.* 1994. Vol. 5, No. 3.

Barton, C.D., and A.D. Karathanasis. 1996. *Renovation of a Failed Constructed Wetland Treating High Metal Load Acid Mine Drainage in the Rock Creek Watershed.* In 1996 Kentucky Nonpoint Source Pollution Conference Proceedings, Kentucky Division of Water, September 1996.

Channing L. Bete Company, Inc. 1995. *What Everyone Should Know About Land Reclamation.* Channing L. Bete Company, Inc., South Deerfield, MA.

Channing L. Bete Company, Inc. 1995. *What Everyone Should Know About Coal.* Channing L. Bete Company, Inc., South Deerfield, MA.

Conservation Technology Information Center (CTIC). n.d. *Building Local Partnerships.* Conservation Technology Information Center, West Lafayette, IN.

CTIC. n.d. *Getting to Know Your Local Watershed.* Conservation Technology Information Center, West Lafayette, IN.

Devlin, P.W. 1994. Mill Creek Reborn: A Mining Story. *Pennsylvania Resources* 5(3):2-3, 1994.

Dick, W.A., J.V. Bonta, F. Haghire, and J.R. Page. 1983. Stream Water Quality of Two Small Watersheds Affected by Surface Coal Mining. *Journal of Environmental Quality* 12(3):351-358.

Durkin, T.V., and J.G. Herrmann. *Focusing on the Problem of Mining Wastes: An Introduction to Acid Mine Drainage.* Reprint from EPA Seminar Publication No. EPA/625/R-95/007, Managing Environmental Problems at Inactive and Abandoned Metals Mine Sites. Obtained from Internet: <http:www.infomine.com/technomine/enviromine/publicat/amdintro.html>.

Garden, J. 1994. Stonycreek-Conemaugh River Improvement Project. *Pennsylvania Resources* 5(3):7-8.

Haering, K.C., and W.L. Daniels. 1991. *Development of New Technologies for the Utilization of Municipal Sewage Sludge on Surface Mined Lands.* Final Report. Virginia Polytechnic Institute and State University, Department of Crop and Soil Environmental Sciences, Blacksburg, VA. October 1991.

Heunisch, G.W. 1987. *Lime Substitutes for the Treatment of Acid Mine Drainage.* Mining Engineering. pp. 33-36.

Hyman, D.M., J.W. Hawkins, R.L.P. Kleinmann, and G.R. Watzlaf. 1995. *The Art and Science of Mine Drainage Prediction (paper).* Attachment to letter from William J. Kovacic, Field Office Director, OSM Lexington Office, to Carl Campbell, Commissioner, Kentucky Dept. for Surface Mining, Frankfort, KY, November 29, 1995.

Joost, R.E., R.J. Olsen, and J.H. Jones. 1987. Revegetation and Minesoil Development of Coal Refuse Amended with Sewage Sludge and Limestone. *Journal of Environmental Quality* 16(1)65-68.

Kentucky Division of Water and University of Kentucky Agronomy Department. 1996. *Kentucky Coal Mining Practice Guidelines for Water Quality Management.* Natural Resources and Environmental Protection Cabinet, Commonwealth of Kentucky. March.

Management Institute for Environment and Business. n.d. *Environmental Partnerships: A Field Guide for Nonprofit Organizations and Community Interests.* Available from the Management Institute for Environment and Business at (202) 833-6556.

Mancuso, A. 1992. *How to Form a Nonprofit Corporation.* Nolo Press, Berkeley, CA.

Maryland Department of the Environment. 1996. *MDE Receives Federal Grants for Two Acid Mine Remediation Projects in Garrett County.* Press release MDE No. 069-96, October 24, 1996.

Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement. 1991. *Adopt-a-Stream Workbook.* Massachusetts Riverways Program.

North Carolina Cooperative Extension Service. 1995. *Watershed Management Planning and Managing a Successful Project to Control Nonpoint Source Pollution.* North Carolina State University, College of Agriculture and Life Sciences. May.

Office of Surface Mining, Appalachian Clean Streams Initiative. n.d. *Appalachian Clean Streams Initative: A Plan to Clean Up Streams Polluted by Acid Drainage.* Office of Surface Mining, Washington, DC.

Pennsylvania Coal Association. 1995. *Pennsylvania Coal Data 1995.* Pennsylvania Coal Association, Harrisburg, PA.

PA DEP, Bureau of Mining and Reclamation. 1995. *Information About the Mine Subsidence Insurance Fund.*

PA DEP. 1996. *Pennsylvania's Abandoned Mines: Problems and Solutions.* Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation, Wilkes-Barre, PA. March. Obtained from Internet: <http:\\www.dep.state.pa.us/dep/nres/bamr/Documents/DEP1494.htm>.

PA DEP. 1996. *Pennsylvania's Comprehensive Plan for Abandoned Mine Reclamation.* Draft. Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation, Wilkes Barre, PA. August. Obtained from Internet: <http:\\www.dep.state.pa.us/dep/nres/bamr/Documents/Comp_Plan.htm>.

PA DEP. 1996. *Ten Percent Set Aside for Acid Mine Drainage Abatement.* Pennsylvania Department of Environmental Protection Fact Sheet. Pennsylvania Department of Environmental Protection, Harrisburg, PA.

PA DEP. 1996. *Toby Creek Watershed Association Hosts Clean-Up Open House.* DEP Update, October 25, 1996.

PA DER, Bureau of Water Quality Management. 1994. *Water Quality Assessment 305(b) Report.* Commonwealth of Pennsylvania, Harrisburg, PA.

Pennsylvania Environmental Council. 1996. REG/NEG Update. *FORUM* 25(1), May, 1996.

Rainford, S.T. The Oven Run Watershed Project: How Effective Coordination Can Work. *Pennsylvania Resources* 5(3):9.

Robertson GeoConsultants, Inc. 1996. *Constructed Wetlands for Treatment of Mine Drainage: Introduction, Coal-Generated CMD, Natural Neutralisation of an Acidic Mine Discharge by a Small Wetland.* October, 1996. Obtained from Internet: <http:www.info-mine.com/technomine/enviromine/wetlands>.

Squillace, M. 1990. *The Strip Mining Handbook: A Coalfield Citizens' Guide to Using the Law to Fight Back Against the Ravages of Strip Mining and Underground Mining.* Environmental Policy Institute and Friends of the Earth, Washington, DC.

Stoneycreek-Conemaugh River Improvement Project (SCRIP). *Passive Treatment Technologies.* Obtained from Internet: <http://ctcnet.net/scrip/passive.htm>.

Terrene Institute. 1991. *Organizing Lake Users: A Practical Guide.* Terrene Institute, Washington, DC.

Terrene Institute. 1992. *Federal and State Cooperative Effort to Reduce Acid Mine Drainage in the Middle Fork River Watershed.* Terrene Institute, Washington, DC. April.

Terrene Institute. 1993. *Clean Water in Your Watershed: A Citizen's Guide to Watershed Protection.* Terrene Institute, Washington, DC.

Terrene Institute. 1996. *A Watershed Approach to Urban Runoff: Handbook for Decisionmakers.* Produced in cooperation with USEPA Region 5. Terrene Institute, Washington, DC. March.

Terrene Institute. 1995. New Acid Mine Drainage Clean-up Plant Opens in Pennsylvania. *Nonpoint Source News-Notes.* March/April 1995, Issue No. 40. Terrene Institute, Washington, DC.

The Keystone Center. 1996. *The Keystone National Policy Dialogue on Ecosystem Management.* Final Report. The Keystone Center, Colorado. October, 1996.

U.S. Department of Agriculture. 1993. *Oven Run: Resource Plan and Environmental Assessment.* U.S. Department of Agriculture, Soil Conservation Service. Harrisburg, Pennsylvania. July 1993.

U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement. 1995. *An Overview of Factors to Consider in the Evaluation of Potential Hydrologic Impacts of Underground Mines, Including the Potential for Acid Mine Drainage.* Attachment to letter from the Acting Chief, Program Support Division, Eastern Support Center, Pittsburgh, PA, to Director, Lexington Field Office. March 27, 1995.

U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement. 1995. *Appalachian Clean Streams Initiative: A plan to clean up streams polluted by acid drainage.* U.S. Government Printing Office, Washington, DC.

U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement. 1996. *Monday Creek Clean-Up Project Announced.* News media advisory obtained from Internet: <http:/www.osmre.gov/102296b.txt>. October 22, 1996.

U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement. 1996. *Surface Mining Director Announces $325,000 Acid Mine Drainage Clean-Up in Elk County.* News media advisory obtained from Internet: <http:/www.osmre.gov/102396.txt>. October 23, 1996.

U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement. 1996. *Surface Mining Director Announces $325,000 For Quemahoning Creek Acid Mine Drainage Clean-Up, Somerset County.* News media advisory obtained from Internet: <http:/www.osmre.gov/102396b.txt>. October 23, 1996.

U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement. 1995. *Abandoned Mine Land Program Overview.* Obtained from Internet: <http://www.osmre.gov/AML/amlinter.html>. June 30, 1995.

U.S. Department of the Interior, Bureau of Mines. 1994. *Passive Treatment of Coal Mine Drainage.* Information Circular 9389.

U.S. Department of the Interior, U.S. Geological Survey. On-Line Discussion Groups. *USGS Mine Drainage Newsletter.* Obtained from Internet: <http://water.wr.usgs.gov/mine/archive/online.html>.

U.S. Department of the Interior, U.S. Geological Survey. 1995. *OSM Appalachian Clean Streams Initiative -Update.* USGS Mine Drainage Newsletter, No. 4, December 1995. Obtained from Internet: <http://water.wr.usgs.gov/mine/archive/osm.html>.

U.S. Environmental Protection Agency (USEPA). 1991. *The Watershed Protection Approach* (booklet). EPA/503/9-92/002. U.S. Environmental Protection Agency, Office of Water. December 1991.

USEPA. 1994. *Streamwalk Manual.* EPA 910-B-94-002. U.S. EPA, Region 10.

USEPA. 1994. *Environmental Planning for Small Communities: A Guide for Local Decision-Makers.*EPA/625/R-94/009. U.S. Environmental Protection Agency, Office of Research and Development, Office of Regional Operations and State/Local Relations. September 1994.

USEPA. 1994. *Partnership Tackles Acid Mine Drainage; Section 319 Success Stories.* Office of Water, 841-S-94-004. November 1994.

USEPA. n.d. *The Volunteer Monitoring Guidance on Stream Surveys (Draft).*

USEPA. 1995. *Cleaning Up Contaminated Sediment: A Citizen's Guide.* U.S. EPA/GLNPO. January 1995.

USEPA, Region 3, and U.S. Department of the Interior. 1995. *Statement of Mutual Intent Strategic Plan for Restoration and Protection of Streams and Watersheds Polluted by Acid Mine Drainage from Abandoned Coal Mines: 1995 Progress Report.* USEPA Region 3, Philadelphia, PA.

USEPA, Region 3. n.d. *Coal Mine Drainage Initiative pamphlet.* USEPA, Region 3, Philadelphia, PA.

USEPA, Region 3. 1995. *Nonpoint Source Coal Mine Drainage Projects: Project Summary List.* USEPA, Region 3, Philadelphia, PA. May 1995.

USEPA. 1995. *Statement of Mutual Intent Strategic Plan for the Protection of Streams and Watersheds Polluted by Acid Mine Drainage from Abandoned Coal Mines.* USEPA and U.S. Department of the Interior, Office of Surface Mining. Produced by GSA Mid-Atlantic Region Duplicating Plant. November 1995.

USEPA. and the Pennsylvania Organization for Watersheds and Rivers. n.d. *AMD: A Citizen's Introduction to Restoring and Protecting Streams and Watersheds in the Appalachian Region.*

USEPA. 1995. *Cleaning Up Contaminated Sediment: A Citizen's Guide.* Prepared for USEPA, Great Lakes National Program Office, by the Lake Michigan Federation. January 1995.

West Virginia Department of Environmental Protection. 1996. State Receives $975,000 for Acid Mine Drainage Work. *In DEPth* 3(12), December 1996.

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